Report

OF THE

GOVERNOR'S COMMITTEE

APPOINTED TO INVESTIGATE THE

COAL MINE DISASTER

AT

BEAR CREEK, MONTANA

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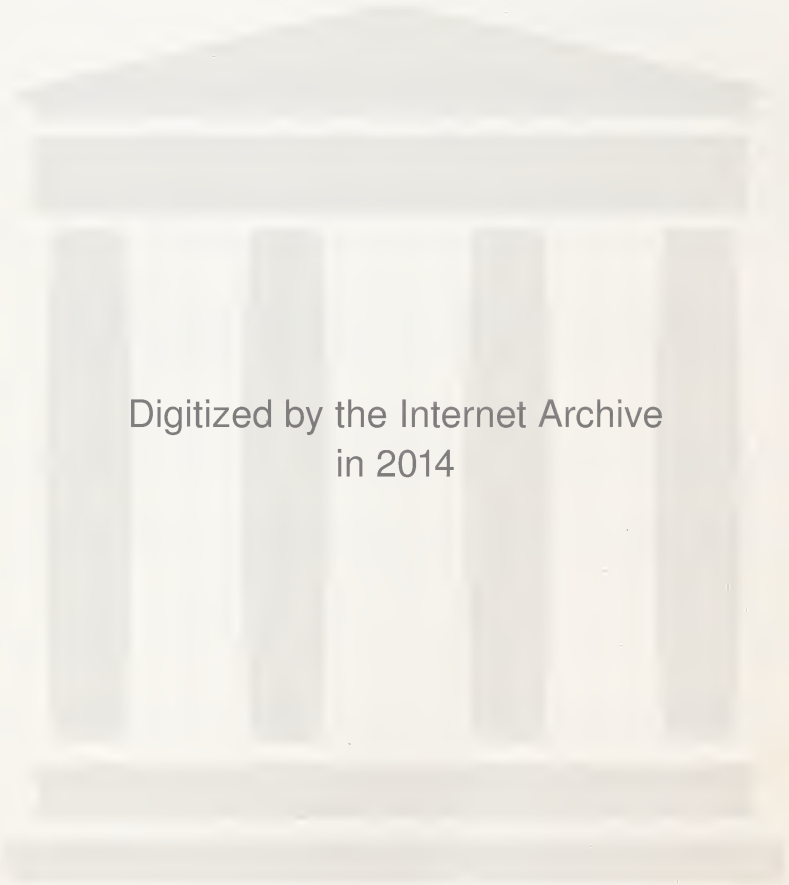


Billings, Montana

July 21, 1943

Honorable Sam C. Ford,
Governor of the State of Montana
Helena, Montana

Dear Governor Ford:

The undersigned, comprising the Committee appointed by you to investigate the mine disaster at the Smith Mine of the Montana Coal & Iron Company, at Washoe, in Carbon County, Montana, respectfully submit the following report:

STATUTORY AUTHORITY FOR INVESTIGATION

House Bill No. 282 of the Twenty-Eighth Legislative Assembly of the State of Montana (page 583 Session Laws 1943) appropriated the sum of Five thousand dollars, or so much thereof as may be necessary, to be expended under the direction of the Governor of the State of Montana in conducting and causing to be conducted a full and thorough inquiry and investigation of the cause of the disaster.

GOVERNOR'S APPOINTMENT AND INSTRUCTIONS

On April 8th, 1943, the Governor made appointment of the following Committee:

Richard H. Dalrymple, of Salt Lake City, Utah;
William Redshaw, of Billings, Montana;
Abe Douglass of Roundup, Montana.

The following excerpts from Governor's letter of April 8, 1943, addressed to Richard H. Dalrymple, as Chairman of the Committee, outline the duties of the Committee and the scope of the investigation:

> "This is to advise you that I have today appointed you to be Chairman of the Committee to investigate the Bear Creek, Montana, mine disaster, and I sincerely hope you will find it possible to serve.
>
> "Your investigation of this tragic occurrence should be as complete and thorough as possible, and when it is finished you are requested to submit a full report of your findings to me. I am certain that the people of Montana are eager to know every possible fact that may have a bearing upon the causes contributing to this terrible mine explosion, so that steps may be taken for the prevention of such disasters in the future."

PERSONNEL OF THE COMMITTEE

Richard H. Dalrymple: Graduate Mining Engineer, B. S. C. and E. M.; twenty years experience in Oklahoma, Colorado, New Mexico and Utah, as mine engineer, miner, fire boss, foreman and superintendent. Chief Coal Mine Inspector of State of Utah, and member of Utah Industrial Commission, in charge of Safety Division.

William Redshaw: Graduate International Correspondence School for Mine Management; forty-eight years mining experience, in and around coal mines, including fifteen years as miner and laborer at various jobs in and outside of mine, and thirty-three years on such work as foreman, mine manager, superintendent and general superintendent, in the management and operation of coal mines, preparing and marketing coal and general supervision of coal mining properties.

Abe Douglass: Twenty years experience as miner in State of Illinois, and thirty-five years of such experience in Montana, as miner, mine foreman and superintendent.

SCOPE OF THE INVESTIGATION

The Governor met with the Committee at the Northern Hotel in Billings on April 15th, 1943, at which time a general discussion of the matter and the duties of the Committee was had, and the Committee then proceeded to Red Lodge.

An inquest had been held at Red Lodge and was completed prior to the Committee's arrival; the reporter was requested to furnish the Committee with a copy of the transcript of the evidence, to which reference is hereafter made.

Conferences were had with Mr. G. O. Arnold, Senior Coal Mine Inspector, United States Department of the Interior, Bureau of Mines; Ed Davies, State Coal Mine Inspector of Montana; W. A. Boyle, President of District No. 27, United Mine Workers of America; Joe Masine, International Board Member from District No. 27, United Mine Workers of America and Mr. Yanchisin, also representing the United Mine Workers of America, and W. A. Romek, Loren H. Newman and Tom Freeman, representing the Montana Coal & Iron Company.

On April 16th, 1943, accompanied by men representing the Bureau of Mines, the State Coal Mine Inspection Department, United Mine Workers of America and Montana Coal & Iron Company, the underground workings of the mine were inspected, special attention being given to the portions of the mine in which the explosion occurred and where damage resulted.

Since then transcript of the evidence has been furnished to the members of the Committee, and each member has made a careful study thereof.

In addition, careful study and consideration has been given to reports of the Federal Bureau of Mines, which reports covered inspection before and after the explosion, reports of the Coal Mine Inspector, made before and after the explosion, report of the Montana Coal & Iron Company and officials of the United Mine Workers of America, letter from Montana Coal Operators' Association, verdict of Coroner's Jury, and reference has been made to other sources of information as a basis for this report.

DOCUMENTARY EVIDENCE CONSIDERED BY THE COMMITTEE

This evidence consists of the following:

Preliminary Coal Mine Inspection Report of Department of the Interior, Bureau of Mines, covering inspection of mine made by inspectors of that Department between November 19th and 30th, 1942.

Final Report of the Department of the Interior, Bureau of Mines, covering the inspection immediately above referred to.

Final Report covering the explosion made by Department of Interior, Bureau of Mines, made by inspectors of that Department, and who were present during the rescue work and made an examination thereafter.

Report of Examination made by Ed. Davies, State Coal Mine Inspector of Montana, on January 27th, 1943.

Report covering Explosion, Rescue Work, and Examination of Mine made by Ed. Davies, State Coal Mine Inspector of Montana, to which is attached letter or memorandum of G. O. Arnold, Senior Coal Mine Inspector, Bureau of Mines.

Report on Mine Explosion made by Montana Coal & Iron Company, in pamphlet form.

Report on Mine Explosion made by W. A. Boyle, President, District No. 27, United Mine Workers of America.

Letter of Montana Coal Operators' Association, addressed to this Committee.

Verdict of Coroner's Jury.

Transcript of testimony taken before Coroner's Inquest held at Red Lodge, beginning on April 12, 1943.

Ten Years of Safety Service with Closed Lights, by George H. Deike, Mine Safety Engineer, in pamphlet form.

Copies of these different documents are appended to this report, as a part thereof.

THE EXPLOSION

The explosion occurred in the No. 3 Vein of the so-called Smith Mine, operated by the Montana Coal & Iron Company, on February 27th, 1943. Watches found on some of the victims had stopped running between 9:30 and 9:35, indicating this was the approximate time of the tragedy, this being the forenoon of that day.

Seventy-seven men were underground at the time of the explosion; three of these men were rescued alive; the other seventy-four men died.

As recovery of the bodies proceeded, records were kept of the places where found. A comparison of the places of recovery, with the known place of employment of the individual victims, indicates that some of the men were killed outright by the force of the explosion; while others were found at variable distances, up to one thousand feet from the place of employment, indicating death was caused by gases following the explosion.

The record of mining in your beloved state has been one of accomplishments from its inception. Basic ores and minerals have fed the furnaces of modern civilization. From the days of the prospector to the mining operations of today, both of metal and coal, Montana has made its indelible impression of importance all over the world.

The Smith Mine Disaster is a stigma, comparable to cancerous proportions, to your State's proud record.

The results of this disaster have been the theme of gossip and criticism undoubtedly in every other coal producing State.

Your Committee here assembled want not to rehearse the pallor of death or suffering, but rather to gather around us facts and present them in a dire attempt that action will be taken to prevent reoccurrence of a similar disaster in any coal mine in the State in the future.

It is known throughout the country that disaster in every coal producing State, at some time or another, has carried with it the initiative of State leaders, as well as coal mine operators, to have legislative action taken, so that each and every coal mine operation be governed by laws, with partiality to no particular person or persons, regardless of politics or prestige.

As requested in the portfolio of instructions presented to this Committee, we humbly present facts relayed to us through the medium of testimony, reports and verbal remarks. The nucleus, so given, has been thrown in with common sense, safe mining practices that have stood the test day after day in the mines of other states, through this, our United States.

And now, the salient facts involved in and around the Smith Coal Mine Disaster:

VENTILATION

The system of ventilation employed was produced by a centrifugal fan set on the outside of the mine, assisted by three (3) Booster Fans underground, and which were spotted in different parts of the mine, in an attempt to relay or carry the air throughout the mine.

At the main source of supply, the quantity of air entering the mine was approximately 43,000 cubic feet per minute (measurement as taken by the Federal Coal Mine Inspectors, Report of November, 1942). It has been borne out that this volume was greatly reduced before the air reached the active sections of the mine. This loss was due to air leaks in stoppings. This condition would allow the air to take the shortest course back to the return airway, and then travel back to the surface. Air intended to do a certain ventilating job was short circuited and results it could accomplish were wasted. This was overcome to some degree by work which had been done on the stoppings to prevent leakage, and, if properly controlled, would increase the quantity of air available to the active underground workings.

The mine was ventilated on one continuous current of air, which means it was directed in the first panel and coursed throughout all the underground workings. In employing this system of ventilation, all noxious and inflammable

gases in the mine are mixed with the air and coursed in and through all parts of the mine—the greater the area of mine workings, the higher the percentage of pollution and impurities in the air current. In case of an explosion, it is more likely, as in the Smith Mine, to travel to all parts of the mine.

If this mine had been ventilated on the SPLIT SYSTEM, where each panel had been given its own allotted volume of pure air direct from the main intake source of supply, many advantages would have been gained, which are impossible by a continuous system. Enumerating some:

Adequate volumes could be allotted to panels in direct proportion to the number of men working in them, and the quantity of liberating gases could be determined from constant analysis;

Air would be more healthful for workmen;

Gases generated would be more quickly diluted and removed;

In case of a sudden outburst of gas, and the probable ignition of same, the results would be more likely localized or confined to the immediate vicinity in which it occurred.

It is understood that the greater volume of air entering a mine during the winter months, where the outside air temperature is lower than the mine air temperature, has a tendency for the mine air to absorb moisture, causing a drying-out of the mine workings, which materially increases the potential hazard of a dust explosion. This mentioned condition is present in coal mines every winter and is recognized and known to all competent coal mining men.

Such conditions can be partially, if not wholly, overcome by the generous use of water for sprinkling of haulageways, at working faces, particularly the working faces at time of cutting, after coal has been shot down and during loading operations, also by applying rock dust.

This latter procedure, rock dusting, makes coal dust inert.

We believe the corrections being made, as suggested by the Federal Coal Mine Inspectors, as to enlarging airways, and overcoming air leaks in stoppings, provided a larger volume of air to the mine, and in general would cause a drying out of the mine. On the other hand, this increased volume directed to the working faces would create a more healthful atmosphere for the workmen, the quicker that gases could be diluted and removed, more than compensated for the dryness which it may have caused.

A thorough study of all reports and records submitted to us, relative to the Smith Mine, definetely leads us to believe the ventilation in this mine was not properly taken care of or given the attention it should have received.

Facts pointing to this conclusion are:

1. Brattice lines were too far back from some working faces to force or direct the air current to the faces.

2. Leaks in stoppings.

3. Single doors on haulage ways, which were at times left open, thus shorting and disrupting the ventilation throughout the mine.

The practices employed could have been overcome by brattice lines properly hung, air tight stoppings, double doors installed to form air locks, spaced far enough apart so that in moving of trips, one door would always remain closed while the other was open, thereby preventing a disruption of the ventilation system.

GAS IN THE SMITH MINE

This mine is on record as one of the few mines in the State of Montana known as a gassy mine, and from what we can learn it has generated explosive gas for a long time. Our investigation of this feature consisted of checking the daily reports of the mine examiners' report book, the check being made back from the date of the explosion, which occurred on February 27th, 1943, to July 10th, 1941, and is the period covered by the mine examiners' books turned over to us. These records show that on nearly every examination made during this period considerable gas was being generated in different places throughout the workings of the No. 3 seam, in addition to gas entering the ventilating air current of this seam from the abandoned workings of No. 2 seam of this same mine. This added to the gas generated in No. 3 seam increased the hazard or explosive dangers down in the No. 3 workings.

Daily inspection by Certified Mine Examiners and Mine Foremen were made of all working places in No. 3 seam and records made of findings of explosive gases, but no records were made of the date or time of the removal of the gas, which creates a confusion as to how long gas was allowed to remain and accumulate in these places reported where gas was found.

Furthermore, accumulations of explosive gas should not be allowed to remain and increase any longer than absolutely necessary, which only increases the hazard that is always present in mines of this type, and especially where smoking, mixed lights and nonpermissible electrical machinery are the general practice.

In checking the examiners' daily reports, it was noticeable that generation of gas was not confined to any one part of this mine, but would show up at many points all through the workings. Under the ventilation system of one continuous air current through the workings, as was practiced in this mine, the per cent of gas increased as the air traveled from one section of the mine to another. The splitting of the air by the use of overcasts and sectionalizing of the air current would help this condition.

Furthermore, we feel that sufficient attention has not been given to the daily report of the mine examination inspectors, and later on in our recommendations will suggest that provisions of our present coal mining laws of Montana provide for a daily follow up check and signature of the mine foreman, and weekly check and signature of the Superintendent in charge, and also require the State Coal Mine Inspector, or his deputy, to check over and sign these same reports on each of his regular inspections.

Table of analyses of air samples taken at this mine during Federal Inspections by G. O. Arnold and M. R. Evans, on Nov. 19th to 30th, 1942, analyses

of these samples being made on Dec. 11th and 12th, show that the Methane content ran from 0.08 per cent to 1.52 per cent. This shows that sufficient fresh air was lacking to properly dilute and make safe the gaseous conditions of some parts of this mine. According to the Bureau of Mines Tentative Coal Mine Inspector's Standards, if the air immediately returning from a split that ventilates any group or active workings contains more than .5 per cent of inflammable gas, as determined by chemical analyses in duplicate, or by other recognized means of detection, the workings of that split shall be considered as hazardous and require improved ventilation; if this air contains more than 1.5 per cent of inflammable gas, the workers should be withdrawn until ventilation has been improved.

The use of a Methane Detector, as recommended further on in this report, would have kept the Management informed regarding a condition of this kind.

COAL DUST

Coal dust is always present in a coal mine and is made by cutting, drilling, loading and the movement of haulage trips.

The finer the coal dust, the greater the amount that goes into suspension in the air current and is deposited on timbers, ribs, floor, crevices and other places throughout the mine.

This dust, if played upon by a flame of sufficient intensity, ignites, thus spreading and picking up additional dust, and results in an increase of violence until its force is spent and it dies out.

Certain safeguards can be taken in the operation of a mine which will reduce this danger, namely:

Rock dusting.
Sprinkling of water.
Permissible electrical equipment.
Properly installed electric wiring.
Adequate ventilation.

In the Smith Mine, which was classed as moist to wet, we find that wiring was strung and supported in places by being nailed to timbers; that fine slack was allowed to accumulate or was piled alongside of track on rib sides.

These two unsafe practices should never have been permitted.

Rock dust had not been applied, but had been considered at the time of the disaster.

EXPLOSIVES

Black pellet powder was used for blasting coal in this mine, and, as this was a gassy mine, should not have been allowed. This, in itself, was a hazard.

Ignition of this powder was by fuse, this lighting of the fuse was by open light.

The method of transporting the powder around the mine was by attaching the powder car behind a mobile drill, and while there was no evidence presented

to show that black powder had anything to do with the starting of this explosion, the powder in the car was set off and did intensify the explosion and heat at the time, and was one of the contributing factors.

The drillers and shot firers used permissible electric cap lamps, as a safety measure, but the principle and use of the electric cap lamps was destroyed by the use of open flame lighter in lighting the shot, as noted above.

Some shooting was done on shift, while the men were in the mine. Shooting or blasting on shift should only be permitted when permissible powder is used and fired by means of a permissible blasting unit and then only after an immediate inspection has been made by a certified official and is free of gas and found safe.

Recommendations for addition to the mining laws will be made to correct this practice.

ELECTRICAL EQUIPMENT AND INSTALLATION

Reports submitted reveal that electric power lines underground were strung on wet timbers in places and supported on nails instead of insulated hangers.

That power lines were extended into the working places and not properly supported on insulators and some equipment was not grounded.

Sectional switches should have been installed on the main trolley line at the entrance to each panel, and preferably at room necks to cut the power off in those sections when they were not being worked.

CARBIDE LAMPS AND PRACTICE OF SMOKING IN THE MINE

Mixed lights, both carbide and electric cap lamps, were used in this mine, and all men were permitted to smoke underground.

Open or carbide lamps, as well as smoking in the mine, are definitely a source of danger in any coal mine, and should not under any circumtances be permitted.

In a gassy mine, there is always the possibility of an open flame light igniting gas, thereby causing a disaster.

Further, in a non-gaseous mine, there is the ever present danger of mine fires being started, or, under certain conditions, coal dust being ignited.

Regardless of the fact that a mine is classed as gaseous or non-gaseous, the ultimate results are one and the same—the loss of human life and the destruction of valuable property.

METHODS OF DAILY INSPECTION

The practice of inspections in this mine was for one examiner to go in about midnight and start inspecting the mine for unsafe conditions, etc., the other examiner would go on shift at 4:30 a. m., the latter starting his inspections where the former left off or stopped. The examiner starting work at midnight would arrive at the surface at 7 a. m. and enter his findings in the Inspection

Book, and this same procedure was followed by the other examiner, when he came off.

Our criticism of this method is that the examiners did not have a definite assignment or district to examine, which often leads to confusion or misunderstanding in the transmittal between examiners, thus jeopardizing a complete and thorough examination of the mine.

MINE MANAGEMENT AND STATE INSPECTION

After carefully studying and analyzing all the reports submitted to us, we are of the opinion the methods of underground operations and practices in effect were not conducive to safety, dating back to 1941, which is the extent of available information.

For example: "The Daily Inspection Record" discloses that the finding of inflammable gases was a common occurrence, and in numbers far in excess of what you would expect in a well ventilated and properly managed mine.

Other conditions were known which were hazardous.

Officials in direct charge of underground operations should, from training and experience, be capable of insuring safe working conditions for all workment and protection of their property.

The Montana Coal Code may not have been so worded as to name every potential hazard which is known or otherwise related to coal mining, nor does any other State code.

In November, 1942, this mine was thoroughly inspected by Inspectors of the Federal Coal Mine Inspection Department, United States Bureau of Mines, and a preliminary report, showing the many unsafe conditions, was made available to the management, as well as the Montana State Inspection Department. This report was written so that it could be easily interpreted and understood by men familiar with coal mining terminology.

Had the State Coal Mine Inspector, in his regular inspection of the Smith Mine, January 27th, 1943, approximately two months following the issuing of the Federal Coal Mine Inspection Preliminary Report and exactly one month prior to the explosion, checked the report against the existing conditions at the mine, more complete information would be available as to how rapidly the mine was getting out of control.

The State Coal Mine Inspector's Report did not disclose that he checked what recommendations were being carried out, as recommended by the Federal Inspectors, but only comprised recordings of air readings taken by him, which would lead one to believe that the mine was in a satisfactory condition.

No recommendations or orders were noted on the State Inspector's Report.

RECOMMENDATIONS

Introductory to our recommendations, it is well to point out the fact that the present coal mining code of Montana was adopted in 1911 (Chapter 120, Laws of 1911), and that since then the method of mining coal has materially changed, particularly in that mechanized mining of coal has been largely introduced into the industry. While amendments have been made to this coal code, it is well to bear in mind the value of a new code to cover the conditions now existing. We do not believe that it is within the province of this Committee to suggest what should be included if a new code is formulated, but we will direct our recommendations to some things which we believe are imperatively necessary, as demonstrated by this explosion.

Inspection

Coal Mine Inspector Davies (transcript page 79) indicates his belief that he is without authority to order a portion of a mine closed where hazards exist; the Montana Coal Operators Association (letter to Committee under date of July 10, 1943), indicate its belief that the present laws are adequate, citing Section 3021 Revised Codes Montana, 1935.

The Section cited by the Association is to be found in the workmen's compensation law.

The Committee does not express any thought whether the present laws are adequate, but in order that there be no doubt of the Inspector's duty and authority, it is suggested that specific statutory authority be given to the State Coal Mine Inspector to order remedied condition or to close such portion of a mine, as in his belief is immediately dangerous to the miners therein employed.

As illustrative of what has been done in other States, we quote from the Utah code (section 1519, par. 2 coal laws):

> "If the inspector finds that a mine is not properly worked, or is not furnished with proper machinery or appliances for the safety of the miners and all other employees, it shall be his duty to give written notice to the owner or manager of such mine that it is unsafe, and such notice shall specify in what particulars the mine is unsafe, and shall direct the owner or manager thereof to make such improvements as are necessary within a reasonable period. If the improvements are not made as required in the notice, it shall be unlawful for the owner or manager to operate such mine until such improvements are completed."

Specific attention is directed to Chapter 113 Laws of 1941, and the amendment therein appearing with reference to ventilation. It is to be noted that the method of correcting ventilation is left to agreement between the State Inspector and the Mine Management, and in the absence of such agreement, there is no duty on the Management to make correction.

It appears to this Committee that if inspection is to be adequate and of value, the power should be lodged with some official to direct what should be done, and it should not be left to agreement. It may be true that sole power lodged in an official may permit arbitrary action on the part of such official, but experience in the industry does not show that such result follows.

DEFINITION AND REGULATION OF A GASEOUS MINE

It is recommended that legislation be enacted defining and regulating a gaseous mine.

The Utah definition is quoted, by way of illustration:

"Section 20. (a) . . . A gaseous mine shall be considered as one in which inflammable gas can be detected in any working place on three different working dates within a period of thirty days, or if, from such place or places, samples of the air can be gathered which show, by chemical analysis, one per cent or more of inflammable gas, or if one-half per cent or more can be found in any return current, as determined by chemical analysis.

(b) A mine will also be classified as gaseous if inflammable gas, as determined in the preceding paragraph, can be found in abandoned workings which are not bulkheaded off, or if there is liable to be an inrush of gas due to falls or caves of the overlying strata, as determined by conditions in the mine or in adjoining or nearby mines.

(c) Upon finding the presence of gas in any part of a mine, classed as non-gaseous, a report shall at once be made to the Industrial Commission."

Section 19 of the Utah code provides:

"Under no circumstances shall any shot firer fire shots in a place containing gas, and must not fire in such place until same has been cleared of gas through approved methods of ventilation."

Section 21 of the Utah code provides:

"(d) It shall be unlawful for any owner, operator, superintendent, mine foreman, or any employee of any mine which generates explosive gases to remove any accumulated body of gases by wafting or brushing. All such bodies of gas must be removed from the mine by approved methods of ventilation.

(e) In nongaseous mines the inspection by fire bosses must be made the same as in gaseous mines, unless permission not to do so is granted in writing by the Commission."

Section 72 of the Utah code:

"(a) In all cases where authorized shot firers are employed and where the powder is taken in of a sufficient quantity that it is transported on haulageways, either by rope, motor or horse, the powder must be transported in a non-conductive safety-built car for powder only.

(b) All powder taken into the mine shall be kept in a box constructed of non-conducting material. The box shall be kept at least twenty-five feet from the tracks or power lines in all cases where room at such a distance is available.

Detonators must be kept in a separate box, or a separate compartment in the same box, and the box used only for storage of the above material."

Section 78 of the Utah code:

"(a) In gaseous mines, worked out areas shall either be sealed off with explosion and fireproof bulkheads, or they shall be fenced off, well posted with danger signs and so ventilated as to prevent any accumulation of noxious gas. In non-gaseous mines, worked out areas shall either be sealed off or posted with danger signs and so ventilated as to prevent any accumulation of noxious gas.

(b) Air from worked out areas must be conducted into the return airway without passing through working rooms or entries."
Section 65 of the Utah code:

"In all mines classed as gaseous all operators of coal cutting machines, electric drilling machines, and coal loading machines must be furnished safety lamps for testing and examining each place for gas before taking said machines in by last open cut through, and in no instance must any person incompetent to understand operation of flame safety lamp and detection of gas be allowed to operate any of said machines. And in all cases when place is found to contain gas said machines are not allowed to enter. In detecting gas during operation of machines, operation must cease, power be cut off machine, and gas findings reported to foreman or person in charge. Machine operation must not continue until place is freed of gas."

INSTALLATION OF NEW EQUIPMENT

All new electrical equipment installed be of a permissible type, the statute to define "permissible type" to be of the standards prescribed by the Federal Bureau of Mines.

MINE EXAMINERS AND THEIR DUUTIES

It is recommended that Section 3516 Revised Codes of Montana, 1935, be amended by inserting the words "within three hours prior to the time of a shift going on duty," after the word "work" in line six of the section.

That Section 3516 Revised Codes of Montana be further amended by inserting the words "said record to be signed by the examiner when made, countersigned by the foreman daily and by the superintendent weekly, and by the State Coal Mine Inspector on his regular periodic visit" after the words "office of the company" on the fourth line from the end of the section.

That legislation be enacted requiring non-gaseous mines to be examined the same as gaseous mines, unless permission is otherwise granted, in writing, by the Industrial Accident Board.

SMOKING UNDERGROUND

That legislation be enacted prohibiting smoking or carrying of matches in any mine where electric cap lamps are required to be used, and that a periodic search be made by officials of the company of the workmen before going on shift.

ROCK DUSTING

It is recommended that legislation require the rock dusting of mines. Sec. 54 of the Utah code is cited by way of illustration.

"(a) The rock dusting shall be done with such regularity and frequency that all surfaces required to be rock dusted in dry mines shall be kept in such a condition that the incombustible content of the adhering dust shall not be less than fifty-five per cent (55%) in non-gaseous mines and sixty-five per cent (65%) in gaseous mines.

(b) The rock dust shall be distributed on roof, sidewalls, floor, and on top of all timbered sections of all main haulageways, all active entries to the last open cross-cut, and to a distance of not less than 50 feet in all active rooms and pillar workings and return airways. Whenever, by analysis, the rock dust material in any part of a mine so treated, shows a total incombustible content lower than that determined as necessary to render the coal dust inert, the section in question shall be fenced off, or the mine closed until sufficient inert material has been added to allow of safe operations.

(c) In all worked-out sections of the mines from which haulage facilities have been removed to the extent of making the cost of rock dusting prohibitive there shall be installed rock dust barriers so placed that an explosion originating in that level or panel cannot extend to other parts of the mine. These rock dust barriers shall be of a type which has been tested and approved by the U. S. Bureau of Mines, and shall be correctly installed."

ELECTRIC LAMPS AND SAFETY LAMPS

That legislation be enacted requiring the use of electric lamps and safety lamps in all mines, Sec. 49 of the Utah code being quoted by way of illustration.

"(a) Lighting. All men entering coal mines in Utah in which more than five men are employed on any one shift shall be equipped with electric battery lamps approved by the U. S. Bureau of Mines, and no flame lamps shall be permitted in the mine, except for testing purposes. All lamps used for testing purposes shall bear the approval of the U. S. Bureau of Mines and shall be magnetically locked and the igniters shall be maintained in a servicable condition. Mines employing five men or less on any one shift may be required to comply with the above regulations at the direction of the Industrial Commission of Utah."

VENTILATION

It is recommended that legislation be enacted providing that motormen or rope riders shall not leave any trips or cars standing where same may materially obstruct ventilating current.

Further, that all electric haulage, in gaseous mines, be on the intake air way.

Further, where arc welding is being done underground in a gaseous mine, a certified man must first inspect and report it safe before starting the welding.

That where doors are necessary on haulageways, they be installed in pairs, spaced far enough apart so that one door will be closed at all times, when trip is passing, thereby preventing a disruption of ventilating current.

Where shooting is permitted on shift, an inspection, by a certified man, must be made immediately prior to and after blasting has been done.

That all stemming used must be of inert material; tamped in sufficient quantity to prevent blown out shots.

That water be supplied and used when cutting and loading is being done, to wet down all coal dust that may arise and accumulate in and around the working face.

ELECTRIC EQUIPMENT AND WIRING UNDERGROUND

That the Bureau of Mines standards be adopted.

That no electric driven booster fans be installed underground in a gaseous mine.

RESCUE AND FIRST AID

That all employees should take first aid training and mine rescue training should be given to those employees, who are physically fit to receive it.

That all underground employees should be supplied with self-rescuers.

That all underground employees, and surface where necessary, should be required to wear skull guard, with visors attached (mine caps), and safety toed shoes.

For the purpose of establishing central rescue stations, we suggest and recommend that the State be divided into three districts, Bearcreek, Roundup and Giffin; that eighteen sets of artificial breathing apparatus of a type approved by the U. S. Bureau of Mines, and necessary accessories be installed and kept at Roundup, twelve sets of the same at Bearcreek, and six sets of the same for the Giffin district; with some particular person assigned to see that they are kept in proper condition at all times; and that there should be at least two men trained in the wearing and use of each set of apparatus. One methane detector should be kept at each rescue station.

METHANE DETECTOR

Methane detector should be kept at all mines known to generate explosive gases, and a test, and record of the same, should be taken in the return air, at least weekly.

State Coal Mine Inspector should also be supplied with a methane detector.

CONCLUSION

The above recommendations are not intended to cover all improvements that can be made by reason of statutory enactments, or otherwise, and are merely suggested as some of the required improvements which this tragedy demonstrates are necessary.

A careful and thorough study of the present coal mining code of the State should be made by members of the Legislature, officials of coal companies and representatives of the workmen, and an attempt made to enact laws, and introduce safety measures, which will place the State in the forefront of those States requiring safe mining practices.

We wish to stress the necessity of alert and intelligent management, especially with reference to safe mining practices, and the cooperation of em-

ployees therein, and also the absolute necessity of strict mine inspection by the State Coal Mining Inspection Department, with insistence on its part of faithful observance of all present provisions of the coal code, and of future enactments. These provisions of the code are based upon the lessons learned in the day to day operation of coal mines, and while there will always be danger of explosion, and other disasters in this industry, a close observance of the coal code will minimize the danger.

The Committee has given considerable time, thought and study to the matters concerned with this tragedy and the recommendations herein made, and we deem it a privilege to have been selected for this important duty. If anything set forth herein will make for greater safety in the coal mines of the State, we will feel amply repaid for our efforts in the matter.

It is our opinion that the explosion was caused by the accidental igniting of gas at some undetermined place in the mine, which in turn caused the coal dust to go into suspension and be ignited and spread to practically all parts of the No. 3 Vein, killing some of the men outright, and this was followed by monoxide gas, which took a further toll.

We wish to express our sincere appreciation to all those who have submitted reports and given other valuable assistance to this Committee.

Respectfully submitted,

R. H. DALRYMPLE, Chairman,
WILLIAM REDSHAW, Member,
ABE DOUGLASS, Member.

Dated July 22, 1943

UNITED STATES

DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

PRELIMINARY REPORT

Smith Mine, Montana Coal & Iron Company

Washoe, Montana

November 19 to 30, 1942

—Inspectors—

G. O. ARNOLD and M. R. EVANS

The facts disclosed by the inspection of this mine, including both commendable conditions and practices and those which should be given corrective measures, will be embodied in a detailed report to be made available to the public, in accordance with the Federal Coal Mine Inspection and Investigation Act of 1941, H. R. 2082.

The purpose of this preliminary report is to point out good features as well as certain unsafe practices and conditions that should be corrected promptly.

Ventilation: The mine is ventilated by a centrifugal fan on the surface, assisted by three booster fans installed underground. The 43,470 cubic feet of air per minute entering the mine is sufficient to provide proper ventilation; however, only about half of this air is reaching the working section in No. 3 bed.

Numerous caves and narrow stretches along the intake airway in No. 2 bed, together with the small cross-sectional area of the shaft down to No. 3 bed, offer excessive resistance to the flow of the air current. The intake airway should be enlarged along the narrow portions and caved material should be cleared away; the size of the airshaft should be increased substantially.

Stoppings between the intake and return airways in No. 2 bed are mostly constructed of concrete. Considerable air is leaking past a number of doors in these stoppings and the doors should be made airtight.

Stoppings between the intake and return airways in No. 3 bed are constructed of two layers of boards, with a layer of bituminous-treated, reinforced paper between. According to air readings taken, leakage through these stoppings results in a substantial loss of air. All of these wooden stoppings should be repaired and made airtight.

Single, wooden doors are used across the main south haulageway and in the entrance to each panel to confine the continuous air current to the working panels. A trapper tends two of the doors on the main south haulageway and one door to a working panel. Otherwise, haulagemen leave the doors open, when entering a panel, and the doors stay open until the locomotive and crew pass through when leaving the panel.

All doors should be kept closed, except when haulagemen and equipment are actually passing through them. Leaving doors open while trips are being gathered interferes with the ventilation of the working places.

Air at Working Places: The working faces are ventilated by a continuous current of air. Panels on the west side of the main south entries are well ventilated as the continuous air current passes through them first.

Leakage of air through doors and wooden stoppings reduces the volume of air reaching the panels on the east side. The humid condition of this air current, together with the contamination resulting from ventilating other workings, make it desirable that the volume of air reaching the east side of the main south entries be substantially increased.

Stoppings between rooms are constructed of brattice cloth, and line brattices are used to conduct the air current from the last open crosscuts to the working faces. A number of these stoppings and line brattices are in need of repair.

Gas: According to the fire-bosses' report, gas is reported daily in a number of places in each of several panels. During this inspection, traces of gas were found in a number of rooms, a small quantity of explosive gas in room 10 off 6 south-east panel, and substantial quantities of explosive gas at the inby end of the 6 southeast panel entries and in an old place driven to the rise off the inby end of the old 4 east panel. The return air current generally, in panels outby the 7 south-east panel, shows indications of gas.

It is important that the fire bosses examine daily all workings through which the ventilating current passes before reaching the outby working places. Old working should be examined each week.

Explosive gas should not be permitted to accumulate and stay in any part of the mine. When a quantity of gas is discovered, work should be suspended and electric power cut off in that portion of the mine outby the body of gas, and the power should remain cut off until the gas is properly removed by improved ventilation.

The presence of indications of gas in the air current generally outby the 7 south-east panel makes it important that the volume of air reaching this portion of the mine be substantially increased. All doors and stoppings should be made as airtight as is reasonably possible and line brattices generally should be extended closer to the working faces.

Both open and closed lights are used in the mine and smoking is permitted. The use of open lights and the permitting of smoking in a mine, as apparently gassy as this mine, is highly dangerous. Smoking should be discontinued immediately and all men should be searched frequently and regularly for smoking materials. Permissible electric cap lamps should be provided for all employees as soon as is reasonably possible. Until closed lights are provided for all employees, the mine officials should see that every place in which a man with an open light works is tested for gas with a flame-safety lamp before the man enters and several times thereafter during the working shift.

The mine foremen should carry flame-safety lamps at all times while on duty and test every place for gas during their examination of the working places.

Control of Coal Dust: Water is used to allay coal dust on one combination cutting and shearing machine only. Preparations are being made to provide water for the arcwall cutting machine and the shearing machines; water should be provided at these machines as soon as is reasonably possible and used on the cutter bars while coal is being cut.

Rock Dusting: Rock dust has not been applied to any part of the mine. Efforts should be made to secure an approved type of rock dust and the mine should be rock dusted. Haulageways and working sections of the mine should be rock-dusted first. The rock-dusting of coal mines is the most dependable method of combating the coal-dust explosion hazard.

Explosives: The Management should consider using a permissible type of explosives in place of black powder for blasting coal. Certain hazards exist when black powder is used and, until replaced by a suitable type of permissible explosives, precautions should be taken to minimize the hazards, as follows:

1. Instantaneous electric squibs, fired by permissible blasting units, should be used for firing all shots. Fuse, ignited by open lights or matches, should not be used.

2. Blasting should not be done until all men other than the shot-firers are out of the mine.

Regardless of the type of explosives used, certain precautions should be taken in the interest of safety, as follows:

1. Only sufficient explosives to last one day should be taken into the mine at one time. Too large a supply of explosives is being stored underground at this time.

2. Explosives should be stored in substantial boxes, provided with locks and kept locked when not in use, in each working section.

   Explosives should be carried in canvas or similar bags to the faces by the shot-firers, as needed. Explosives should not be hauled about the mine in a car hitched behind the drilling machine, as is now the practice.

3. Wooden tamping bars should be used in place of copper-tipped metal bars.

4. Holes should be stemmed only with adobe or other incombustible material. Fine coal should not be used, as is now the practice.

5. Preferably, all holes should be stemmed to the collar, but in no case should the tamped stemming extend less than 24 inches from the charge.

6. Holes should not be charged while electrical equipment is in the place.

7. Tests for gas should be made with a flame safety lamp before and after firing each shot, or round of shots.

Electrical Equipment, Wiring and Guarding: Electric power is transmitted into the mine through a 3,800 volt, 3-wire circuit enclosed in metal conduit. This circuit enters through a borehole and extends to the working section in No. 3 bed. A three-wire branch circuit extends from near the drill hole to a set of transformers in a crosscut below the inside hoist. These wires should be placed in a metal conduit, or an armored cable should be used.

Five rotary converters installed underground provide 250-volt direct-current power. Large-size bare feeder cables extend from the converters to various parts of the mine. These feeder cables are generally supported on posts by track spikes or nails. All bare feeder cables should be supported on insulators.

Most of the trolley circuits are supported properly on insulated hangers; however, the insulated portion of the hanger is missing in many places. Properly insulated hangers should be used to support all trolley wires.

Solid bare feeder wire is used to extend the direct-current power from the trolley circuit into each working place and the wires are supported on nails driven into posts or crossbars. Connection with the trolley circuit is made by twisting one end of the feeder wire about the uninsulated portion of a hanger, just above the trolley wire. These wires should be installed on insulators and proper fittings should be provided for attaching the wires to the trolley-wire hangers.

At the time of the inspection all feeder and trolley wires on the direct-current circuit were continuous and not provided with cut-out or sectionalizing switches. As one of the booster fans is operated by a direct-current motor, one of the rotary converters is operated continuously and the entire direct-current system is energized as a result. The management reports that a sectional switch has since been installed inby this fan and that power is now cut off the trolley and feeder wires in the No. 3 bed workings when the mine is idle.

A number of sectionalizing switches should be installed on the direct-current feeder and trolley wires so that power can be cut off any idle portions of the mine. Also, cut-out switches should be installed on trolley wires at the entrance to each panel and on feeder wires at the entrance to each working place.

Electrical equipment generally is well installed, except as follows:

High-voltage danger signs are needed at a number of installations. Insulated platforms are needed at a number of 440-volt and 3,800-volt switches.

Exposed gears should be guarded on three of the small plunger pumps.

The belt on the air compressor being used in the 4 west panel should be guarded. The open-type controller, which is on the belt-side, should be covered.

Guards should be placed over the emery wheels in the underground shop. Several belts on the shop equipment should be guarded also.

The flexible coupling on the inside hoist should be guarded. A passageway into the hoist room leads in under the hoisting rope. A covering should be constructed over this passageway, in under the rope, to protect persons from contacting the rope when traveling through.

Timbering: Working places, haulageways, and passageways are generally well timbered. However, timber generally is well back from the working faces. An effort should be made to keep timber set as close to the faces as is reasonably possible, considering the type of loading equipment used.

Haulageways, Roadways, etc.: The slope haulageway in No. 2 bed is narrow and shelter holes are needed, especially for several hundred feet inby the portal, to provide a safe place for workmen when trips are passing.

The rock slope extending from No. 2 bed down to No. 3 bed is very narrow and a number of shelter holes should be provided as soon as is reasonably possible. All employees normally travel into and out of the mine in man-trips, but it is necessary for officials and workmen to travel the haulageways occasionally.

Clearance along other haulageways is reasonably good, except at partings where proper clearance is provided along one track only. Center props at these partings constitute a hazard. The roof is such that it is questionable whether the partings could be widened sufficiently to give proper clearance on both tracks. Haulagemen should be cautioned frequently by the mine officials as to this hazard.

The coal ribs along the haulageways in some parts of the mine tend to slough and it would not be good practice to remove all the loose coal. However, road cleanings have been piled along the ribs in places and this refuse should be loaded into mine cars and removed from the mine.

Roadways generally are reasonably clean but there are a number of switches and other places where some coal spillage is evident. This spillage should be loaded into cars and removed from the mine.

Lighting: Illumination along the haulageway is fair. Additional lights are needed generally at switches, partings, and doors.

An old trolley-wire circuit extends into the large centrifugal pump. This circuit is used to provide power for lights only. The wire is nailed to wet timber, is in under the gob in places, and is generally poorly installed. Preferably, this wire should be removed and insulated wires installed for a lighting circuit.

Underground General: About 10 per cent of the employees wear safety caps and safety shoes. None was observed wearing goggles. All employees should wear safety caps and safety shoes, and all employees should wear goggles, preferably at all times while at work, but at least when doing work that is hazardous to the eyes.

Additional first-aid dressing material should be available in the mine. If necessary, at least one metal box containing first-aid supplies should be taken into each of several working sections daily and returned to the mine office at the end of the shift.

When the man-trip is being hoisted from the mine, a safety bridle, extending from the motor to the first car, should be used.

Employees were observed jumping off the man-trip on the surface, and underground, before the trips stopped. This is a hazardous practice and will lead to a serious or fatal injury if continued. Employees and management should cooperate in stopping this dangerous practice.

It is a common practice in this mine to move cutting, drilling and loading equipment, and cable-reel locomotives by "nipping." This is an unsafe practice and should be discontinued.

A guard rail is needed around the top of the downcast airshaft extending from No. 2 to No. 3 bed.

Considerable timber and wooden planking are used about the underground hoist and this creates a serious fire hazard. An effort should be made to reduce to a minimum the combustible material about this installation.

The handles of all axes used underground should not be over 18 inches in length.

Surface Hazards: The tipple, washery, and small-coal storage bins have numerous mechanical and electrical installations in and about them. Very few of the gears are guarded and there are many exposed gear assemblies that should be guarded immediately. None of the belt or chain drives is guarded and proper guards should be installed. Numerous floor and wall openings are in need of guard rails.

Two hoists near the railroad tracks below the tipple, used for moving railroad cars, have exposed gears that should be guarded.

The small hoist used to handle empty mine cars has exposed gears that should be guarded.

Insufficient clearance is provided between railroad cars and tipple bents, also the bents of the tipple carrying the mine track. Suitable warning signs should be posted at all such points and workmen should be warned frequently as to the hazards.

A number of small holes are present in the flooring of the trestle extending from the tipple to the mine. Apparently, rollers have been removed at these points. These holes should be covered. A portion of the guardrail along the west side of the trestle is loose and should be repaired.

At least two entrances should be provided in the wash house. The entrances should be on opposite sides of the wash house so as to provide safe exits for the men in case of fire.

The drive chain and belt from the motor to the head shaft of the elevator at the sand-drying house should be guarded.

In the shop, the following equipment is in need of guarding: two emery wheels; all belts; old control panel for the lathe motor; flywheel on compressor; and one circular saw.

About 10 per cent of the outside employees wear safety caps and safety shoes. Goggles are provided in the shop for use when welding, using emery wheels, and running lathes. Mechanics appear to wear the goggles when doing this type of work. Otherwise, goggles are not worn by employees on the surface.

All employees on the surface should wear safety shoes and all employees in and about the tipple should wear safety caps. Goggles should be worn by all employees, preferably at all times while at work, but at least when doing work that is hazardous to the eyes.

Excellent fire protection is provided on the surface.

Cooperation: It would appear that there is very little cooperation between employees and management in connection with the establishing and enforcing of safety practices. The management and employees should mutually assist and support all efforts toward greater safety in and about the mine.

General Comments: Full cooperation was extended during the period of this inspection by both employees and management. All maps and information requested were given freely.

(SIGNED) G. O. ARNOLD, Inspector

M. R. EVANS, Inspector

COAL MINE INSPECTION REPORT

Smith Mine, Montana Coal & Iron Company

Washoe, Montana

November 19 to 30, 1942

By

G. O. ARNOLD,
Coal Mine Inspector

M. R. EVANS,
Coal Mine Inspector

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

INTRODUCTION

This is a report of an inspection made in accordance with the Federal Coal Mine Inspection and Investigation Act of 1941, H. R. 2082, for the purpose of obtaining information relating to health and safety conditions in coal mines, such information to be made available to the public as required by law.

The intention of this report is to indicate both safe and unsafe conditions and practices prevailing at the mine so that the industry, the public, and all concerned may be informed as to what is being done at this mine to bring about more healthful and safer conditions and practices. It is hoped that this report will help the management and the mine employees in their efforts to improve the safety of this mine.

GENERAL INFORMATION

Location and Ownership

The Smith mine is owned and operated by the Montana Coal & Iron Company. The mine is on a branch line of the Montana, Wyoming & Southern Railroad Company at Washoe, about 50 miles northeast of Laurel, Montana, which is the junction point of the above railroad with that of the Northern Pacific Railway Company.

Operating Officials

C. R. Smith, President, Menasha, Wisconsin.
J. M. Freeman, Vice President and General Manager, Washoe, Montana.
W. R. Freeman, Superintendent, Washoe, Montana.
Adolph Steinmasel, Master Mechanic, Red Lodge, Montana.
Elmer Price, Mine Foreman, Red Lodge, Montana.

Other Mines Operated by the Same Company

The company also operates the Foster mine, which is about 4 miles from the Smith mine.

History of the Mine

The mine was opened in 1889 by the present company, and railroad shipments began in 1907.

One ignition of gas is reported as having occurred in a place off the 4 east entry in No. 4 bed, in 1939. The arcing of the controller of a mobile loading machine is considered to have been the source of ignition. No one was injured.

A fire is reported as having developed in April of 1941 near what then was the face of the main south entries, close to the present underground shop. Some top coal had been blasted down at the end of the shift, the fire was discovered the following day, and it took 8 days to extinguish it. The employees were handicapped in their efforts to fight the fire as all haulageways were on return air. The exact cause of the fire was not determined. No one was injured as a result of this fire.

A gas explosion is reported as having occurred in February 1918 in the No. 3 bed workings of the old Washoe mine. This mine is in property adjoining that in which the Smith mine is located. The ignition of the gas is reported

to have been caused by an open cap lamp. Five men were burned but all recovered. Otherwise, there is no record of serious fires, gas ignitions, or explosions in other mines in the district.

Type of Mine

The old mine in No. 2 bed was opened by three slopes driven in a southwesterly direction on the full pitch of the coal bed. About 3,700 feet inby the portal a rock slope was driven down to the No. 3 bed, and workings in this bed were developed from this point. An inside shaft was driven between the two coal beds, near the junction of the rock slope with No. 3 bed, to provide the second airway. A rock slope from No. 2 bed up to No. 1 bed and thence to the surface, and an untravelable connection with the old Foster mine in No. 2 bed are the only other openings to the surface.

Coal Bed

The present mine is in the No. 3 bed of the Bear Creek coal field. Classed as subbituminous, the coal bed ranges from 9 to 10 feet in thickness and dips from 3 to 10 per cent in a southwesterly direction. A maximum cover of 1,200 feet is over the present mine.

The following log shows the position of known coal beds in this area:

	Feet
Shales and sandstone to surface	50 to 950
No. 1 coal bed	6
Shales, sandstone	150
No. 2 coal bed	8
Shales, sandstone	90
*No. 3 coal bed	9
Shales, sandstone	80
No. 4 coal bed	5
Shales, sandstone	75
No. 5 coal bed	4
Shales, sandstone	20
No. 6 coal bed	4
Shales, sandstone	150
No. 7 coal bed—coal and "bony"	33

*The No. 3 coal bed is the one now being mined.

The coal on the right side of the main south entries is reasonably clean but impurities are found in the coal bed on the left side. Two cross sections of the coal bed on the left side are as follows:

Cross section No. 10 room 7 southeast panel

	Feet	Inches
Coal	2	6
"Bony" coal	....	2
Coal	3	1
"Bony" coal	....	2
Coal	1	4
Rock	1	....
Coal	1	....
Total	9	3

Cross section at face of 7 southeast panel

	Feet	Inches
Coal	3	1
"Bony" coal	—	2
Coal	3	3
Clay band	—	4
Coal	1	7
"Bony" coal-clay	—	10
Coal	1	1
Total	10	4

The coal below the lower rock band is not mined.

A face sample was collected August 15, 1939 by a representative of the Bureau of Mines. This sample, designated as Laboratory No. B-42518, was analyzed August 31, 1939 in the laboratory of the Bureau of Mines in Pittsburgh and gave the following results:

Moisture	10.5 per cent
Volatile matter	33.6 per cent
Fixed carbon	43.1 per cent
Ash	12.8 per cent
Total	100.0 per cent
Sulphur	0.8 per cent
B. t. u.	10,490

The ratio of volatile matter to the total combustible matter, as given above, $\frac{\text{Volatile matter}}{\text{Volatile matter plus fixed carbon}}$ is 04.38. Experiments conducted by the Bureau of Mines have shown that dust from coal having a volatile to total combustible ratio of 0.12 is explosive, and that the explosibility increases as the ratio increases. Accordingly, dust from the coal in this bed is highly explosive and would readily initiate or propagate an explosion.

Number of Employees

At the time of the inspection 257 men were employed as follows:

	First Shift	Second Shift	Third Shift	Total
Surface	60	49	0	109
Underground	79	68	1	148
Total	139	117	1	257

The first shift enters the mine at 7:40 a. m. and is out at 3:35 p. m. The second shift enters at 3:55 p. m. and is out at 11:50 p. m. At present, coal is dumped at the tipple on both shifts. Employees are all paid by the day or by the month.

Production

The mine produces an average of 1,800 tons of coal in 24 hours; a maximum of 2,200 tons has been produced in one day; and 352,124 tons were produced in 1941. All coal is loaded mechanically, and the life of the mine is estimated to be about 50 years.

SURFACE PLANT AND EQUIPMENT

Tipple

The tipple has a capacity of 1,200 to 1,400 tons of coal in one 7-hour shift. Constructed of wood and covered with corrugated sheet metal, the tipple structure is a fire hazard.

The loaded mine cars are passed through a single-car rotary dump. Any standard size of coal may be prepared over the shaking screens in the tipple.

All 4-inch by 2-inch coal is sent to the washery and all minus2-inch coal is conveyed to the small-coal bins in a near-by structure; these buildings are constructed of wood and are covered with corrugated sheet metal.

The washery is near the tipple. Pulsating jigs are provided to wash the coal. A shaking screen in the washery is used to separate the coal into several sizes. The 4-inch by 2-inch washed coal is loaded directly into railroad cars, and the minus 2-inch coal is conveyed to the small-coal structure. A vibrating screen is provided in the small-coal structure for sizing the coal.

A part of the wiring is installed in conduit, but only part of the remaining wiring is properly installed on insulators. Open-type motors are used, but most of the switches are of the enclosed type. The frames of the motors are not grounded.

Considerable coal dust is apparent on and about the tipple, and it appears that the tipple is not cleaned frequently. Provision is not made to allay any of the coal dust at points where it is made.

All stairways are in good condition and provided with handrails except the one at the ground level near the railroad tracks. This stairway does not have handrails.

The various machinery in the tipple, including the shaking screens, is crowded into small space, and many hazards exist wherein persons inspecting or greasing the machinery must climb over or under moving parts. Approaches are not provided to the positions where "bony" pickers stand when the tipple is operating; these men must climb over moving machinery when entering or leaving their working positions. A new dumping and screening section is being constructed alongside of the present tipple. This structure consists of steel framing and supports, but the flooring and the wall framing are evidently to be of wood. The attention of the management was called to the necessity of providing safe approaches to the various machinery and working positions in this new structure.

Very few of the mechanical, gear, and belt installations about the tipple are guarded. Many of these are exposed and dangerous. Guards are needed at all of these points.

Provision is made to oil-treat the coal, if it is desired. No hazards were observed in connection with the installation.

Steam is piped about the tipple and is used for heating purposes.

There is insufficient clearance between railroad cars and the tipple bents, and also between the railroad cars and the bents supporting the trestle from the tipple to the mine. Signs are not posted calling the attention of the workmen to these hazards.

Refuse Disposal

Refuse loaded into mine cars and removed from the mine is dumped into a small wooden bin separated from the tipple. Bins in the washery and tipple structure, near the railroad tracks, hold the refuse from the washery and from the tipple.

Refuse is hauled by motor trucks from the bins to the refuse dump located about a quarter of a mile from the tipple. The refuse at the dump is on fire, but the dump is so located that any hazard is minimized.

Coal-Storage Bins

Coal is stored in a number of bins for short periods of time. The bins are as follows: One 150-ton metal-lined raw-coal bin in the washery; four 50-ton metal-lined wooden bins in the small-coal structure; and one 50-ton wooden bin for domestic coal, located under the railroad tracks east of the tipple. There were no hazards apparent in the method of storing coal.

Surface Haulage

Surface haulage consists of the track from the mine portal to the main hoist and a short backswitch to the tipple. The track is in good condition, but the frogs, guardrails, and lead rails are not blocked. Upright throws are provided at the switches; a stumbling hazard is present at such throws. The switches to the tipple and shop tracks serve as derails when trips are beyond them.

Trips are pulled out of and lowered into the mine by an electric hoist. Trolley wire is installed along this haulage road to facilitate the shifting of locomotives to and from the shop, and the wire also serves as a 250-volt direct-current power conductor to the surface.

A wooden trestle supports the track between the tipple and the mine portal. A stumbling hazard exists along this trestle where rollers have been removed and the floor openings left uncovered. Several lengths of guardrail near the center of the trestle, on the west side, are loose and in need of repair.

In handling railroad cars to and from the tipple, the car droppers use substantial brake sticks and car movers, but they do not wear safety belts.

The "runaround" track is on the highway side of the domestic coal bin. Engine crews appear to use caution when handling cars about the mine, but signs are not posted cautioning truckers to look out for the engines and cars. A derail is installed on the lump track above the tipple, and derails are provided on the yard tracks below the tipple.

Hoisting Equipment

A single-drum hoist driven by a 150-h.p., 440-volt motor is used in hoisting loaded trips from the mine and lowering them to the tipple. The hoist is well installed and appears to be well maintained. The 1½-inch rope is in good condition; it is resocketed when inspections indicate that it is needed and is oiled every four months, according to the officials. A reliable trip-position indicator is properly installed, but a signal code is not posted.

Devices to prevent overwinding or overspeeding are not provided. Such devices are needed to protect men riding in the man-trip and also to protect the equipment. The single brake appears to be effective and in good condition. The flanges extend at least 4 inches when all rope is wound on the drum. The hoist installation is isolated from other machinery.

Hoisting engineers are not required to undergo physical examinations, but they are licensed by the State of Montana. A second engineer is not present

when man-trips are being hoisted or lowered. This applies also to the underground hoisting engineers.

Inspections of the hoist and rope are made daily by the engineers, but records are not kept of the inspections.

The hoist house is of wooden frame construction covered with corrugated sheet metal. The inside walls of the building are plastered and the floor is constructed of concrete. All enclosure has been erected about the control mechanism to provide a warm place for the engineer. The materials of which this enclosure are made are not fireproof, and a fire hazard exists. An electric-strip heater provides heat for the enclosure.

Wiring for the hoist is in conduit. An open unguarded 440-volt switch is provided on the control panel, and an insulated platform is needed at the switch. The resistance coils for the hoist are installed in one corner of the old power house nearby, and they are enclosed by a fence. The frame of the hoist motor is not grounded. A flexible coupling on the hoist needs to be guarded, and the projecting set screws on the main-shaft collar also are a hazard.

A "snubbing" hoist is installed in a small, wooden frame, corrugated-sheet-metal-covered structure located a short distance north of the switch to the tipple. This hoist is used to pull empty trips out of the tipple pocket to expedite the movement of trips during rush periods. A five-eighth-inch rope is used on this hoist, and the hoist is driven by a 50-h.p., 220-volt motor. Exposed gears and resistance coils at this hoist need to be guarded.

Power for the bell-signal system on the rope-haulage roads inside and outside of the mine is taken from the 250-volt direct-current circuit. This voltage is much too high for safety and the bare signal wires are contact hazards.

Steam Plant

Three low-pressure steam boilers are installed in a room partitioned off one end of the building which also houses the shop. These boilers carry a maximum pressure of 25 pounds per square inch but are usually operated at a pressure of 10 pounds per square inch. One of these boilers is used to provide steam heat for the tipple, washery, shop, and other buildings. Two of the boilers are used alternately to provide hot water for the wash houses. The boilers are inspected annually by a State inspector.

Suitable water glasses, gages, and pressure-release valves are installed on the boilers, and five exits are provided from the boiler room.

A bucket elevator is installed at the boiler room to elevate coal to a metal hopper. The gears at the top of this elevator are not guarded.

A small shed at the end of the boiler room is used to store cement and other supplies. Heavy machinery and machine parts are stored in a shed adjoining the front of the boiler room; these are not neatly stored and stumbling hazards exist.

Electric Power

Electric power at 50,000 volts alternating current is received from the Montana Power Company.

Surface Transformer Stations

The main transformers are well installed in the open, but they are not enclosed by a fence. An insulated platform is placed at the control switch, the frames of the transformers are grounded, and danger signs are posted.

Switches for the mine circuits are installed in a small wood-framed-and-lined structure which is covered with corrugated sheet metal. The door to this building is kept locked. Such a structure is a fire hazard and is a threat to the continuity of power for the mine. Lightning arresters are installed on the high-voltage lines.

Power is reduced from 50,000 to 4,400 volts at these transformers, and auxiliary lines extend to the several transformer stations about the tipple, to the drill hole for the mine circuit, and to the Foster mine, which is operated by this company.

Secondary transformer installations on the surface reduce the voltage from 4,400 to 440 and 220 volts for use on the tipple, in the washery, and elsewhere about the surface. They are located as follows:

A new set of transformers is being installed to serve the tipple, and the old installation, which is on a raised platform near the tipple, will be removed. The new transformers are installed upon a raised platform on the hillside north of the tipple. The installation is not completed.

The set of transformers for power in the washery, shops, and other places on the surface is installed upon a raised platform about 8 feet above the ground. The installation is on the hillside north of the washery, and it is not fenced. A "High Voltage-Danger" sign is posted, but the frames of the transformers are not grounded. Cut-outs fitted with fuses are installed on the high-voltage lines, but an insulated platform is not provided upon which to stand when the cut-outs are opened.

Transformers for the main hoist are installed on the hillside east of the hoist house. The transformers are a few feet above the ground but are not enclosed by a fence. A "High Voltage—Danger" sign is posted, but the frames of the transformers are not grounded.

Substation

A new substation is being installed north of the shop building. The wooden frame and sheathed building is covered with composition roofing paper, and the floor is constructed of concrete. The 150-kw. set will generate power at 250 volts direct current; it is equipped with a 150-h.p., 440-volt motor. The frame of the set is not grounded, but the mechanic stated that a ground wire would be installed.

Surface Power and Trolley Lines

The trolley wire from the mine to the tipple is well installed on insulated hangers. The wire is from 5 to 6½ feet above the rail and is not guarded at any point.

Auxiliary power lines are properly installed on crossarms attached to poles. The wires are supported on insulators and are high above the ground.

Shops

The shop building is a wooden frame structure covered and lined with corrugated sheet metal, and the floor is constructed of concrete. All wiring is in conduit, and enclosed switches are provided to control electric lights and equipment operated from the 220-volt alternating-current circuit.

The following equipment is exposed and in need of guarding: one double emery wheel and one wheel of another, all belts, the old control panel for the lathe motor, the flywheel on the air compressor in the carpenter shop, and one circular bench-saw. The ladder used in oiling the line-shaft bearings is not equipped with nonskid shoes. The motor on the compressor in the carpenter shop is very dirty and is a fire hazard; a barrel of oil is stored very close to this motor. None of the electrical equipment is grounded. Gasoline in an ordinary 2-gallon metal can is stored in the shop.

The electric locomotives are repaired in the mine; therefore, a repair pit is not needed on the surface.

The mechanics all have shielded goggles, and those doing welding have colored goggles and shields. These men observed doing work that was hazardous to the eyes were wearing goggles. Hand tools were in good condition and free of mushroom heads. The shops were reasonably clean.

Wall-type steam radiators are used to heat the building.

The blacksmith and the mine-car-repair shops are in a building located northwest of the tipple. This wooden frame building is covered with corrugated sheet metal, and the two shops are separated by a wooden partition. The walls, ceiling, and floor of the blacksmithing room are covered with boards; the other room is unlined, and the floor is made of packed earth. All wiring is in conduit, and coal-burning stoves are used to provide heat. The double emery wheel and the belt drives in this building are not guarded.

Fan and Fan House

The 5-foot centrifugal fan which provides the ventilating current for the mine is installed in front of, and just outby, the entrance to the intake airway. The fan operates blowing and is connected by an unguarded V-belt drive to a 25-h.p., 220-volt alternating-current motor. Neither reserve power nor an auxiliary fan is provided. Direction of the flow of the air current can be reversed by the use of doors built into the fan housing; the air current is reversed occasionally but not regularly. Explosion doors are provided on the top of the air duct, but they would not give protection to the fan in the event of an explosion.

A water gage is not provided. The electric light, installed near the fan house, continues to burn as long as electric power is reaching the fan motor; however, this light would not indicate that the fan was down because of a broken belt. A device to cut off the mine power in case the fan should slow down or stop is not provided.

The steel fan housing is connected to a concrete structure which forms the air duct and motor room. A guard is not provided over the intake opening to the fan.

An inspection of the fan is made daily by the electrician. The fan is not operated from an independent electrical circuit; however, it is operated continuously, and all men are out of the mine when it is down. After being down, the fan is operated for two hours, and the mine is examined and reported clear by a fire boss before the men are permitted to enter.

Explosives-Storage Magazines

The walls of the main storage magazine are 12 inches thick and are constructed of brick. The roof is constructed of a double thickness of 1-inch wooden sheathing covered with corrugated sheet metal. A subfloor is not provided over the 6-inch concrete floor, and the walls are not lined. The eighth-inch metal door is provided with substantial hinges, bar, and bolt, and is secured by a 5-tumbler lock.

The magazine will hold a maximum of 35,000 pounds of explosives, but 25,000 pounds is the maximum quantity stored at one time. The magazine is not barricaded and is 3,500 feet from the mine entrance, 500 feet from the nearest dwelling, 600 feet from a public highway, 3,000 feet from the nearest electrical equipment, and 6,000 feet from the refuse dump. The magazine can be used safely to store only 300 pounds of explosives, according to the American Table of Distances. A new magazine, safely located, is needed for the storage of explosives.

A danger sign is posted on the door to the magazine. Ventilators are not provided. Natural light is depended upon for illumination. Materials other than explosives are not stored in the magazine, and the interior is kept clean. Some dry grass and brush is within 50 feet of the magazine.

A record is kept in the mine office of all explosives and fuse removed from the magazine.

A detonator-storage magazine is maintained. This magazine is partitioned off a building used for the storage of old electrical equipment. The concrete walls are 7 inches thick, and the stone partition is 12 inches thick. The concrete roof is 7 inches thick and is covered with asphalt. A subfloor of 1-inch planks over 2- by 4-inch joists is provided. The door is constructed of 2-inch planks, is attached by heavy strap hinges, and is secured by a 5-tumbler lock.

Ventilation is provided by three unguarded 2-inch pipes extending vertically through the roof. A danger sign is posted properly.

This magazine is used to store fuse, a few boxes of gelatin explosives, and several hundred detonators. Some mine supplies also are stored in the room. A number of detonators attached to lengths of fuse are hanging on the wall, and the lids were off several metal boxes of detonators. According to the management fuse is tested to determine the burning rate.

The magazine is about 75 feet from the foremen's office and about 700 feet from the mine portal. Open lights are not used in or about either of the magazines.

Wash House

The wash house is a wooden-frame structure covered with corrugated sheet metal. The walls and ceiling are lined with wood, and the floor is constructed

of wood. Several small extensions to the main structure are built entirely of wood, except for the corrugated-sheet-metal roof covering. The floors in the shower rooms are made of concrete, the building is kept clean, and twenty showers are available for use.

Toilet facilities are not provided in the wash house, and the nearest such facilities are in the shop yard, about 200 feet away. A wooden ventilator is installed in the roof, illumination is provided by electric lights, and heat is provided by wall-type steam radiators. Pipe radiators are used in one shower room, and they are guarded. Disinfectant foot baths are not provided.

Wooden lockers are available for 182 men.

A small shower room is provided in the shop building for the use of the mechanics. A radiator on the wall of the shower room is a contact hazard.

Another small shower room is maintained at one end of the mine-office building for the use of the mine officials.

Supply House

The main supply house is a wooden frame structure covered with corrugated sheet metal and provided with a wooden floor. An office room for the mine officials is partitioned off one end of this building.

Supplies are stored in a reasonably orderly manner. Wiring for the electric lights is installed in conduit. Heat is not provided in the supply room and is not needed. The officials' office is heated by steam radiators.

A small frame structure, covered with corrugated sheet metal and located just west of the mine office, is used to store electrical armatures, miscellaneous equipment, and other supplies. The supplies and equipment are stored in a disorderly manner and many stumbling hazards are present.

An old wooden dwelling is used for the storage of some heavy equipment and supplies. According to the management, a new warehouse is to be constructed soon for the storage of this and other equipment and supplies.

Lamp House

A regular lamp house is not provided, but one will be needed if permissible cap lamps are obtained for all underground employees. At present, the 75 permissible electric cap lamps are charged, serviced, and stored in one end of the boiler room. A few of the cap lamps are of the latest type, the others being of an older type. The cap lamps appear to be kept in good condition.

Four flame safety lamps of the keylock type, but with the locks disengaged, are in use. Flame safety lamps of a permissible type are needed to insure safety in their use. Also, a cabinet is needed in which the flame safety lamps can be placed, ignited in an explosive mixture of gas and air, and proved to be safe for use. Naphtha for use in the flame safety lamps is stored in a 1-gallon glass jar which is kept upon a shelf; this is a fire hazard.

Other Buildings

The mine-office building is of wooden frame construction, covered with corrugated sheet metal. The floor is constructed of wood, and the walls and

ceiling are lined with composition wallboard. Illumination is provided by electric lights, and heat is provided by steam radiators.

A first-aid room is provided in a small building west of the mine office. This building is similar in construction, lighting, and heating to the mine office. A lavatory is installed in the room, and a water closet is provided in a partitioned-off enclosure. Toilet facilities for the outside employees are provided in a small room at one end of this building but separate from the first-aid room.

A sand-drying house is maintained east of the mine office .The wooden frame building is covered with corrugated sheet metal. A coal-burning stove of special design is used to dry the sand. An elevator is provided to elevate the sand to a bin attached to the structure, but the chain and belt drives on this elevator are not guarded.

Yards and Materials

The yards about the mine are congested, especially during the winter months, and it is difficult to find space for supplies, old mine cars, and scrap piles. Some improvement will be possible in the storing of these items when construction work on the surface is completed.

Surface Fire Protection

The wooden trestle between the mine and the tipple begins about 30 feet outby the mine portal. Otherwise, there are no inflammable structures within 100 feet of the mine portal.

Fire-fighting equipment is provided as follows: two of the 3-quart carbon tetrachloride fire extinguishers are kept in the top of the structure housing the small-coal bins. Similar extinguishers holding 1½ quarts each are placed in the following buildings: three in the small-coal structure; one in the mine officials office; one in the supply house; one at the tipple dump; one in the tipple scales room; two in the washery; two in the shop; one in the hoist house; one in the wash house; and one in the mine office. Hose and fire hydrants are located as follows: one hydrant and 50 feet of 2-inch fire hose are in the shop; a hydrant and 400 feet of 2-inch hose on a cart are in a small room at one end of the first-aid room; a fire hydrant is in the washery; one is on the surface east of the tipple; one is near the hoist house; and one is near the railroad tracks south of the tipple.

An adapter is available that will make it possible to use fire hose from Red Lodge, Montana, on the local fire hydrants. The fire-fighting equipment is not checked or tested at any given periods, and a fire-fighting organization is not maintained.

A building for the storage of oil is a short distance north of the shop; it is a frame structure sheathed with wood, and has a roof of corrugated sheet metal. The floor is constructed of wood, and some evidence of oil spillage was observed. Several barrels of oil and a square tank which will hold about two barrels were in the building. Illumination is provided by electric lights, and heat is provided by steam radiators. "No Smoking" signs are not posted at the oil house. The building is a fire hazard.

Water Supply and Housing

Only four company-owned houses are maintained at the mine. Most of the employees live in Red Lodge, Montana, about 7 miles west of the mine.

Water for use about the mine and in the washery comes from a number of springs west of the mine and higher in elevation. This water is stored in tanks on the hillside near the mine, and there appears to be sufficient available for reasonable protection against fire.

Checking System

Members of the various underground working crews are checked visually before the man-trip enters or leaves the mine. A more dependable method is needed for checking the men into and out of the mine.

UNDERGROUND MINING METHODS, CONDITIONS, AND EQUIPMENT

System of Mining

The present mine is worked by the room-and-pillar method. Main cleavage planes run in a northwesterly direction and were disregarded in planning the mine.

The three main south slopes in No. 3 bed are being driven on 3- to 4-percent grades due south, half across the pitch, and the faces of the slopes are now about 4,000 feet from the old 4 east entries, off which they were turned. These slopes are driven 14 feet wide on about 70-foot centers, and crosscuts are driven 100 to 150 feet apart.

Cross entries, in pairs, are turned right and left off the main south slopes at 300- to 400-foot intervals. The cross entries driven to the right are turned at right angles to the main south slopes and are on a slight downgrade. Cross entries turned to the left are turned at 45-degree angles and are practically level. These entries are driven the same width, on the same centers, and with crosscuts at the same distances as described for the main entries. Entries in old parts of the mine were driven 10 feet wide.

Rooms are turned at 45-degree angles off the cross entries, and on 100-foot centers, as the cross entries advance. The rooms are driven 22 feet wide, leaving a 48-foot pillar between the rooms. Crosscuts are driven 100 to 150 feet apart. The rooms range from 350 to 450 feet in length and, as a rule, do not break into the adjacent panel, but occasionally a room is driven through to assist in the ventilation.

Pillars are not recovered in the present workings.

All coal is topcut and center sheared to a depth of 9 feet. The cuttings are loaded out with the coal, after blasting.

From 8 to 12 inches of top coal is left to protect the roof. Where the bottom rock band is more than 8 inches thick, the coal below is not recovered. About 41 per cent of the economically recoverable portion of the coal bed, or 37 per cent of the total thickness of the coal bed, is recovered on the advance. At present no further recovery is made.

Roof and Floor

The immediate and main roof, above the top coal which is left for protection, is a shale or sandy shale bedded in thin layers and very fragile. The floor is of the same material and is smooth and medium hard.

One fault crosses the coal bed and ranges in a southwesterly direction. This fault crosses the old 4 east entry about 800 feet outby the top of the main south slopes. There is very little displacement at this point, but the displacement increases toward the southwest. No other disturbances are apparent in the No. 3 coal bed.

Timbering

The 8 to 12 inches of top coal is not disturbed by blasting as the coal is topcut, and the resulting roof is a very good one. Where the top coal becomes loose, it is either taken down or timbered immediately upon discovery.

A row of posts is set on each side of the track in entries, and the posts are set 4 to 8 feet apart. Where unusual conditions are encountered, crossbars are set. The entries are well timbered, but the posts are usually 10 to 20 feet back from the faces. Employees at the face test the roof frequently with picks or bars and set props closer to the face if the top coal becomes loose. It would be preferable to set the posts closer to the faces as a regular practice.

Rooms are timbered in the same manner as entries, and other conditions also are the same.

The timbermen make their own cap pieces and wedges. It would be safer and more economical to furnish prepared cap pieces and wedges for use underground.

Timber is not recovered in the present mine. A system of timbering is followed, as described above, and it is a good one except for the lack of timber near the working faces. Workmen are given oral instructions by the foremen as to the method of timbering.

Explosives and Blasting

Explosives in the original cases are placed in an insulated explosives car and taken underground about twice each week. The explosives are transported on the night shift to the underground storage magazine where the cases are piled upon a plank subfloor. The door to the magazine is kept locked, except when opened by authorized persons. Proper tools are not provided for opening the explosives cases.

A special flat car with two built-in insulated boxes, is attached to each mobile electric-drilling machine. The practice is to fill these boxes with the required quantity of explosives and tow the car about the mine behind the drilling machines. This is a dangerous practice.

Black pellet powder in 1¾- by 8-inch cartridges, weighing 0.90 to 1.0 pounds each, is used for blasting coal. A small quantity of permissible explosives has been used for blasting coal, but none is being used at this time. Nonpermissible gelatin explosives are used for blasting rock; the fumes from such explosives are injurious to the health of the workmen.

Fuse which is ignited by open lights or matches, is used for firing shots. An average charge consists of 3 or 4 cartridges or 1.5 to 2 pounds of explosives. Holes are cleaned out by permitting the electric drills to run a short time after the holes are completed, and the holes are charged by the shot-firers as soon as they are drilled. Occasionally, holes are charged while others are being drilled in the same place; this is an unsafe practice. The holes observed were drilled properly as to depth and location.

The holes are stemmed with 14-inch "dummies" made of coal screenings, which is an unsafe practice. An average of 4 "dummies" are used in each hole, which results in about 22 inches of tamped stemming. A metal bar, tipped with copper, is used to tamp the stemming.

The charged holes are all fired just before the end of each shift by the two shot-firers who are members of the two drilling crews. The shot-firers are not certified in this state. From 3 to 6 shots are fired in each round, and all employees working on that shift are still in the mine at the time. The roof is tested before blasting, but tests for gas are not made before or after blasting. Fire runs are not made, normally, after blasting on the second shift, until the fire boss enters the following morning for his regular examination. When an idle day follows, the fire boss enters the mine at 1:00 a. m. on that day and makes an examination for fires in all working places. Ample warning is shouted before firing any shots, and precautions are taken to insure that no one is in the adjoining place when two places are coming together.

A record is made of the explosives issued to each drilling crew on each shift, but the shot-firers do not make any reports as to their work.

Adjacent shots are fired in rapid succession, and some of the shots are dependent; the shots are timed by using different lengths of fuse. By using permissible explosives and firing all shots simultaneously, the hazards would be much less than the present practice, wherein black pellet powder is used. Coal dust is apparent in all working places, and this increases the hazards present when blasting with black powder.

The officials state that blown-out shots are rare, and that misfires seldom occur. When a misfire is experienced, the hole is left until the following day. A new hole is drilled alongside of the misfired hole, charged, fired, and the misfired charge is blasted out. Explosives in the misfired charge become saturated with moisture when left overnight.

As previously mentioned, the transporting of explosives behind the mobile drill, the charging of holes while other holes are being drilled in the place, and the use of coal screenings for stemming are dangerous practices.

The shot-firers and drillers use permissible electric cap lamps. A hazard present where mixed lights are used is the possibility of a man with an open light being assigned to a drilling crew in the event that a regular member is absent.

Ventilation and Gas

A volume of 43,470 cubic feet of air per minute is forced into the mine by the main fan, and a total of 45,205 cubic feet of air per minute exhauts out the several return airways. The mine is ventilated by a continuous current

of air, but a large portion of the air is lost because of congested airways and leaky stoppings. Air readings which were taken of the total intake, at points along the intake airway, and at the returns, are as follows:

Main intake, at fan	43,470 cubic feet per minute
Intake below old 6R panel	34,760 cubic feet per minute
Intake outby No. 1 booster fan	32,625 cubic feet per minute
Intake inby No. 1 booster fan	33,264 cubic feet per minute
Intake inby overcast	30,030 cubic feet per minute
Intake inby end of 1 west	26,180 cubic feet per minute
Intake opposite to 5 southeast	21,600 cubic feet per minute

Return airways

Mine portal	22,540 cubic feet per minute
Old manway	3,680 cubic feet per minute
Rock slope to surface	12,685 cubic feet per minute
Old Foster openings (2)	6,300 cubic feet per minute
Total return	45,205 cubic feet per minute

A comparison of the readings outby and inby the No. 1 booster fan indicates that 639 cubic feet of air per minute is being recirculated because of leakage through stoppings. The leakage was verified by the presence in the intake airway of odors from the hoist, which is in the return airway outby this point.

The reading taken opposite to the 5 southeast panel indicates that less than half of the intake air reaches the working section of the mine.

Air readings at the last crosscuts in the various panels are as follows:

Last crosscut in 5 west panel	13,575 cubic feet per minute
Last crosscut in 6 west panel	14,064 cubic feet per minute
Last crosscut in 7 west panel	9,100 cubic feet per minute
Last crosscut in 8 west panel	11,440 cubic feet per minute
Last crosscut in main south entries	11,200 cubic feet per minute
Last crosscut in 8 southeast panel	23,254 cubic feet per minute
Last crosscut in 7 southeast panel	20,000 cubic feet per minute
Last crosscut in 5 southeast panel	10,200 cubic feet per minute

The reading in the 8 southeast panel was taken inby the No. 2 booster fan and indicates that considerable air is recirculated, as only 21,600 cubic feet of intake air per minute is available just outby the first working panel.

Air readings taken of the total return from the main south district at the 5 southeast panel, and of the intake are as follows:

Return from the 5 southeast panel	12,000 cubic feet per minute
Return up the main south haulageway, just outby the 5 south panel	7,875 cubic feet per minute
Total	19,875 cubic feet per minute

The total intake opposite to the 5 southeast panel is ..... 21,600 cubic feet per minute

The difference in these readings no doubt is caused by the opening or closing of doors and the movement of trips.

The total volume of return air at the outby end of the workings in No. 3 bed is as follows:

Upcast shaft to No. 2 bed, in old 4 east panel, just outby the No. 3 booster fan.. 15,520 cubic feet per minute

Slope haulageway in 2 left entry, just outby 4 east panel ..... 15,750 cubic feet per minute

Total..... 31,270 cubic feet per minute

Total intake, inby the overcast at top of the 2 left airway ..... 30,030 cubic feet per minute

Numerous caves and narrow stretches along the intake airway in No. 2 bed, together with the small cross-sectional area of the shaft down to No. 3 bed, offer excessive resistance to the flow of the air current. The management indicated that the airshaft would be enlarged immediately, and that all stoppings would be checked for leakage and would be repaired where necessary. A railing is needed about the top of the airshaft.

The management has stated in writing, since the inspection, that work is underway toward driving a rock slope from the workings in 5 southeast panel up to No. 2 bed and thence to the surface. Further, that a fan will be installed on the surface at this point, and the haulageways in the mine will be placed on intake air.

The volume of air reaching the main south working in No. 3 bed is not sufficient to ventilate the workings properly.

Line brattices are installed from the inby crosscuts to the faces in all places except those going to the dip. The brattices in many places do not extend far enough toward to faces, and difficulty is experienced in keeping the face regions clear of gas. Some of the line brattices are not erected in a substantial manner and are in need of repair. The bratticing material is not treated to make it fire-resistant.

Crosscuts generally are from 100 to 150 feet apart, which increases the difficulty of maintaining line brattices. The recommended practice is for crosscuts to be driven not more than 80 feet apart.

All old workings on the right side of the intake airway in No. 2 bed, above the 8 right panel, are open to the intake air current. Some contamination no doubt results from this exposure of the intake air to old workings.

Old workings on the left side of the haulage road, down to the 5 left panel, have been partly sealed off along a fault line 700 to 800 feet from, and parallel to, the slopes. The old Nos. 10 and 11 panels on the left side are entirely sealed off. Otherwise, all old workings in the No. 2 bed are open to

the return airways, of which the main haulageway is one. The 3 east entry off the old 13 left entry was extended to where contact was made with the old Foster mine in No. 2 bed. Some air returns out the old Foster mine openings, but the passageways cannot be traveled safely because of old caves.

The working section in the old main slope district in No. 3 bed is sealed off. All other workings are ventilated at this time.

The seals referred to above are made by building a wall of short wooden blocks, laid with the ends facing out, and then plastering the exposed face of the seal. Pipes are installed in some of the seals to permit testing of the atmosphere behind the seals, but samples were not collected during this inspection.

The mine map would make a good ventilation map if properly marked. However, the present ventilation system is not a good one.

Three booster fans are installed inside the mine, in No. 3 bed, as follows:

The No. 1 fan is in the intake airway opposite to the 2 left entry. It is a 6-foot propeller-type fan, driven by a 25-h.p., 220-volt open-type alternating-current motor. An enclosed switch is provided, but the V-belt drive is not guarded. The fan is set in a wooden stopping and the motor is installed in the open entry. As previously mentioned, it is apparent that some air is being recirculated by this fan.

The No. 2 booster fan is installed in the back or intake entry of the 8 southeast panel, about 200 feet inby the return airway of the main south slopes. This is a 4-foot double-propeller fan, connected by a V-belt to a 35-h.p., 220-volt alternating-current open-type motor. The fan is set in a wooden stopping and the motor is installed in the open entry. An enclosed switch is provided.

According to the air readings taken, only 11,200 cubic feet of air per minute is available at the lower end of the main south entries, and 23,254 cubic feet of air per minute is available at the last crosscut inby the fan in 8 southeast panel. It is apparent that considerable air is being recirculated by this fan.

The No. 3 booster fan is installed inby the airshaft in the 4 east panel. This is a 6-foot disc fan connected by a belt-drive to a 15-h.p., 230-volt direct-current open-type motor. An open-type switch is used, and this fan also is set in a wooden stopping; the motor is installed in the open entry. The current of air moving through this fan includes leakage pulled from the haulage road, which also is a return airway, but is mostly that volume of air which has entered into the actual ventilation of the working panels in the No. 3 bed. This will be discussed further in conjunction with the analyses of air samples.

The frames of the motors on the three fans are not grounded, and insulated platforms are not provided at the switches. A 3-foot by 5-foot door is installed in each stopping, to one side of the fan.

Most of the stoppings between the intake and return airways in No. 2 bed are constructed of concrete, but all other stoppings in the mine separating the intake and return airways are constructed of boards. Two layers of boards,

with a thickness of bituminous-treated paper between, are used, and the stoppings are mostly well-sealed into the ribs and roof. However, some of the stoppings are leaking, especially where large doors are maintained in them. Small wooden doors of different sizes, both top-hinged and sliding, are installed in the stoppings at reasonable intervals.

Stoppings between the rooms are constructed of brattice cloth.

Two overcasts are functioning in the mine, but neither is now serving a necessary purpose. Both are well constructed of concrete, but the approaches are not graded to reduce the resistance to the flow of the air.

One solid wooden door is used across the haulageway at the entrance to each panel, and across the main south haulageway at each of several points, to confine the ventilating current to the panels. The doors are fitted with latches to hold them open. One trapper is employed at the junction of the 7 southeast and 4 west panels with the main south haulageway, and he tends a door on each of these haulageways near this point. Otherwise, the haulagemen latch the doors open upon entering a panel, and leave them open until they gather a loaded trip and leave the panel. This disrupts the ventilation in the panel affected and is an unsafe practice.

There are no regulators in the mine.

The mine is classed as gassy by the Coal Mine Inspection Department of Montana. According to the fire bosses' reports, gas is reported daily in a number of rooms in each of several panels. During this inspection, traces of gas were found in a number of rooms, a small quantity of explosive gas was found in room No. 10 off the 6 southeast panel, and a substantial accumulation of explosive gas was found extending well outby the face of the 6 southeast panel (now idle, but inby a working panel) and also in an old place driven to the rise off the old 4 east panel. This last-mentioned accumulation of gas is on the return side of the No. 3 booster fan.

Inflammable gas can be detected on the flame of a safety lamp in the air current generally outby the 7 southeast panel.

As previously mentioned, the old workings in No. 2 bed are connected to the old Foster mine, and return air from the Smith mine is passing out through the main entries of the old Foster mine.

Two fire bosses are employed on the first shift. They enter the mine about 3:00 a. m., examine all working places, walk out of the mine to the mine foremen's office, make out their report, and reenter the mine on the man-trip with the regular day shift. They re-examine all places after reentering the mine, especially places where gas was found, and repair and extend line brattices for the rest of their shift. The fire bosses mark the date and their initials at the face of each place examined and mark on a blackboard at the entrance to each panel the places in which gas was found. The two places where accumulations of gas were found had evidently not been visited by the fire bosses as no mention of them was found in the record book. The active ventilating current in the working section of the mine is not sufficient in volume to keep all the working places clear of gas with any degree of dependability.

The fire bosses use permissible electric cap lamps and carry nonpermissible keylocked flame safety lamps during their shift. The flame safety lamps are not kept locked.

One fire boss works on the second shift, entering and leaving the mine on the man-trip. He uses a permissible electric cap lamp, carries a flame safety lamp, examines the working places, and works on stoppings and line brattices during his shift. He records the results of his examination in the record book. The mine foreman does not sign the fire bosses' reports.

The two foremen on the day shift and the one foreman on the night shift also use permissible electric cap lamps and carry nonpermissible keylocked flame safety lamps while on duty. It was apparent that the foremen do not test regularly for gas in the working places, and that they do not examine idle workings with any degree of thoroughness or regularity.

The flame safety lamps are tested by the care exercised in cleaning and assembling them. Flame safety lamps are carried only by the foremen and the fire bosses, but it was observed that the foremen do not keep the flame safety lamps with them during the entire shift.

A methane detector, other than the flame safety lamps, is not provided. The return air is not tested periodically to determine the per cent of inflammable or noxious gases present in it.

When an accumulation of gas is found, a danger sign is placed across the track, but in several places the danger signs were inby the bodies of gas. The two large accumulations of gas discovered during this inspection were not fenced off properly and effectively.

Most of the electrical equipment used in the face regions is of the enclosed type, but the protective covers have been removed from some of the housings over electrical parts. One of the electric drills mounted on a small haulage locomotive is of the open type, but openings have been drilled in the motor cases of the other drills to provide ventilation. Considering the general presence of gas in the mine, this unshielded electrical equipment presents a positive gas-ignition hazard. The same applies to the use of the Nos. 2 and 3 booster fans in return air which contains detectable percentages of inflammable gas. Permissible electrical equipment only should be used in the face regions and in the return air courses in this mine.

Most of the underground employees use open light, and smoking is permitted in the mine. Both are very positive gas-ignition hazards, and a grave danger exists as long as either is permitted in the mine.

The one gas ignition reported in the mine occurred in a place off the old 4 east panel where an accumulation of gas was discovered during this inspection. The reported cause of the ignition was the arcing of the controller on a mobile loading machine.

Nineteen air samples were collected during this inspection, and the analyses and location, where taken, are shown in Table No. 1.

TABLE I

ANALYSIS OF AIR SAMPLES

Lab. No.	Location in Mine	Carbon Dioxide	Oxygen	Methane	Nitrogen	Cu. Ft. Air Minute	Cu. Ft. Methane 24 Hrs.
78126	Haulageway portal, partial return from mine	0.39	20.10	0.38	79.13	22,540	115,224
78127	Haulageway portal, partial return from mine	0.33	20.15	0.33	79.19	.....	.....
78154	Old Foster mine openings, partial return from mine	0.67	18.60	1.45	79.28	6,300	133,358
78155	Old Foster mine openings, partial return from mine	0.69	18.60	1.49	79.22	.....	.....
78156	Airshaft to surface, partial return from mine	0.71	19.35	0.67	79.29	12,685	125,125
78157	Airshaft to surface, partial return from mine	0.77	19.27	0.70	79.26	.....	.....
78158	Manway portal, partial return from mine	0.88	19.16	0.54	79.42	3,680	28,086
78159	Manway portal, partial return from mine	0.67	19.32	0.52	79.49	.....	.....
	All above samples collected on Nov. 30, 1942.				TOTALS	45,205	401,793
77901	Intake at 1 west, before the fresh air current has reached the working section in No. 3 bed	0.32	20.32	0.09	79.27	26,180	32,044
77902	Intake at 1 west, before the fresh air current has reached the working section in No. 3 bed	0.30	20.40	0.08	79.22	.....	.....
77897	Last crosscut in main south entries	0.17	20.37	0.73	78.73	11,200	117,734
77898	Back entry of 5 southeast panel	0.25	19.82	1.38	78.55	10,200	202,694
77899	Return from 5 southeast panel, and inby workings	0.26	19.77	1.52	78.45	12,000	262,656
77900	Return from 5 southeast panel, and inby workings	0.29	19.75	1.49	78.47	.....	.....
77931	Return air in main south haulageway opp. 5 s. e.	0.18	20.26	0.76	78.80	7,875	86,184
77932	Upcast shaft to No. 2 bed in 4 east panel; return air a short distance outby No. 3 booster fan	0.43	10.67	1.11	78.79	15,520	248,072
77933	Upcast shaft to No. 2 bed in 4 east panel; return air a short distance outby No. 3 booster fan	0.38	19.75	1.11	78.76	.....	.....
77934	Slope haulageway in 2 left entry, just outby 4 east panel	0.80	19.06	0.68	79.38	15,780	161,028
77935	Slope haulageway in 2 left entry, just outby 4 east panel	0.76	19.23	0.74	79.27	.....	.....
					TOTALS	31,270	409,100

Air measurements at the above two points represent the total return outby the working panels in No. 3 bed. Above analyses made in Gas Laboratory, U. S. Bureau of Mines, Pittsburgh, Pa.

The analyses of air samples designated as Laboratory Nos. 78126, 78127, and 78154 to 78159 indicate the quality of the air exhausting from the mine. According to these analyses, the carbon dioxide content ranges from 0.33 to 0.88 per cent, the oxygen content ranges from 18.60 to 20.15 per cent, and the methane, or gassy content ranges from 0.33 to 1.49 per cent. The analyses, together with air measurements taken, indicate that 401,793 cubic feet of methane is liberated by the mine in 24 hours. Analyses of air samples collected at the upcast airshaft, which is 2,600 feet inby the haulageway portal, show a carbon dioxide and methane content about double that shown at the haulageway portal. This is another indication of the leakage of fresh air from the intake airway to the return, the fresh air diluting the gases to the figures shown.

The analyses of the air samples collected in the 1 west intake airway, designated as Laboratory Nos. 77901 and 77902, show that the fresh air current picks up an average of about 0.25 per cent of carbon dioxide and 0.085 per cent of methane before reaching the working section of the mine. It is highly probable that most of this gas is picked up by the air current in ventilating the old workings to the right of the airway in No. 2 bed. According to the analyses and air measurements, the workings contacted by the intake air current up to this point liberate 32,044 cubic feet of methane in 24 hours.

An air sample was collected at the inby crosscut of the main south entries; the analysis of this sample is designated as Laboratory No. 77897 and indicates that the methane content of the air current has increased to 0.73 per cent.

The analysis of an air sample collected in the back entry of the 5 southeast panel, designated as Laboratory No. 77898, indicates that the methane content of the air current has further increased to 1.38 per cent. This increase is, no doubt, a result of the gassy condition of the idle 6 southeast panel, through which the air current passes, and in which a large accumulation of explosive gas was found.

Analyses designated as Laboratory Nos. 77899 and 77900 are of air samples collected in the return airway just outby the 5 southeast panel. This is the last working panel ventilated by the controlled portion of the continuous ventilating current, and an average of the analyses indicates that 0.275 per cent of carbon dioxide, 19.76 per cent of oxygen and 1.505 per cent of methane are present.

The main haulage road is traveled regularly by trolley locomotives in No. 3 bed and occasionally in No. 2 bed. Analyses of air samples collected in the haulageway show the following:

		Percentage		
		Carbon-Dioxide	**Oxygen**	**Methane**
78126	Haulageway portal	0.39	20.10	0.38
78127	Haulageway portal	0.33	20.15	0.33
78156	Airshaft to surface	0.71	19.33	0.67
78157	Return off haulage road	0.77	19.27	0.70
77934	2 left haulageway, just	0.88	19.05	0.68
77935	outby the 4 east panel	0.76	19.23	0.74
77931	Main south, outby 5 s. e.	0.18	20.26	0.76

The analyses of the two air samples collected at the upcast shaft in the 4 east entry, and of the two collected on the 2 left haulageway, designated as

Laboratory Nos. 77932 to 77935 respectively, together with the air measurements taken, indicate that the workings ventilated by the air current up to this point liberate 409,100 cubic feet of methane in 24 hours. This quantity of methane is 7,307 cubic feet greater than the total calculated for the returns from the entire mine. The air samples were not collected inside the mine on the same day the air samples were collected at the returns of the entire mine. However, the check is reasonably close.

The seriousness of the gassy condition of this mine cannot be overstressed. Immediate steps should be taken to increase the volume of air reaching the working section of the mine and to remove or minimize the ignition hazards. Under date of December 22, 1942, the general manager of the company wrote this office— '. . . we have improved the volume of our air considerably at the places in question. . . . Since we made the change in the fan and widened the No. 2 upcast our fire bosses report merely traces of methane in just a few places."

Dust

Coal dust is made by the cutting, drilling, blasting, and loading operations in all places. The mechanical loading machines do not clean up a place thoroughly, and generally some small-size coal is apparent on the floor of the working sections. The ventilating current is practically saturated with moisture, and all surfaces in the working section and along most of the haulageways are moist. Considerable sand is used on the rails in the No. 3 bed to aid the haulage locomotives on the grades. This results in much sand being scattered along the haulageway and tends to reduce the combustible content of any dust on the floor. Some dust is apparent on ribs, roof, and floor throughout the mine.

Coal is used generally for ballasting tracks. When refuse is available, it is used. Roadways generally are moist to wet.

Mine cars are topped some when loaded, but not excessively. The cars are reasonably dust-tight, and coal spillage was observed only at a few switches and partings.

One combination cutting-and-shearing machine is equipped with a water tank, a small pump, and a length of hose. When this machine is operating, water is applied to the cutter bar. Preparations are being made to provide the other cutting machines with similar equipment. Otherwise, water is not used to allay coal dust in the mine.

Rock dust has not been applied to any part of the mine. The management stated that they would investigate immediately into the possibility of getting rock dust and rock-dusting equipment. This is important as the application of rock dust in a mine is the most dependable means of minimizing the coal-dust explosion hazard. When the ventilation in the mine is improved, the interior will tend to dry out, and the coal-dust explosion hazard will be increased unless rock dust is applied in sufficient quantity to all dry surfaces.

The company provides respirators for all men who operate drills or cutting machines, but very few of the men were observed wearing them.

Only four dust samples were collected in the mine. The analyses of these samples are shown in Table No. II. The samples are typical of the coal dust in this mine.

TABLE II

ANALYSIS OF DUST SAMPLES

Can No.	Location in Mine	Kind of Sample	Combustible V.+F.C.	Incombustible moisture + Ash	Through 20-mesh
B-90770	5 west haulage road, inby main south	Ribs	74.1	25.9	76.2
B-90771	5 west haulage road, inby main south	Floor	53.8	46.2	66.0
B-90772	5 s. e. haulage road, inby main south	Ribs	74.7	25.3	74.1
B-90773	5 s. e. haulage road, inby main south	Floor	67.8	32.2	61.7

The above analyses were made in the Coal Analysis Laboratory, U. S. Bureau of Mines, Pittsburgh, Pa.

Haulage Underground

Electric hoists are used in handling trips from the 1 west parting in No. 3 bed to the surface, and trolley locomotives are used for all haulage to and from the faces in No. 3 bed. Grades on the rope haulage roads range from 2 to 9 per cent, and on the locomotive haulage roads the grades range from 3 to 6 per cent. Tracks are reasonably well alined and graded.

Roadbeds are wet to dry and reasonably clean, but refuse and road cleanings have been piled along the ribs in a number of places.

All tracks are well laid to a 26-inch gage. Sixty- and forty-pound rails are used on main haulage roads and forty-pound rails are used on all others. Rail joints are secured by splice bars. Ties used on the main haulage road are 6 by 6 by 56 inches in dimension, and those used elsewhere are 4 by 6 by 56 inches. The ties are spaced 18 to 24 inches center to center.

The switch latches are fitted with bridles, but throws are installed at switches on the main line only, and they are of the upright type. Throws are needed at all switches, but those of the upright type present stumbling hazards. The bridle bars and throw rods are depressed below the level of the ties.

Frogs, guardrails, and lead rails are not blocked.

One derail is in use in the mine. It is an electrically controlled derail and is installed in the track below the inside hoist in No. 2 bed and above the rock slope to No. 3 bed. The derail is operated by the trip rider, and when opened it removes the possibility of runaway cars or trips entering the rock slope.

The main haulageway in No. 2 bed was driven by hand, and it is much narrower than the haulageway in No. 3 bed. Insufficient clearance is provided along the haulageway in No. 2 bed generally, especially for several hundred feet inby the portal. Road cleanings piled along the ribs further reduce the clearance.

The rock slope extending down to No. 3 bed is about 400 feet long and very narrow. All employees normally ride into and out of the mine in mantrips, but it is necessary for officials and workmen to travel the haulageways occasionally.

Clearance along other haulageways is reasonably good, except at partings where proper clearance is provided along one track only. Center props between the tracks on partings add to the hazard. The roof is of such an unstable nature that it is questionable whether the partings can be safely widened to give proper clearance on both tracks.

The coal ribs in some parts of the mine tend to slough, and it would not be a good practice to remove all loose coal; however, enough could be removed to provide reasonable clearance.

There are no shelter holes in the mine, but they are needed at switch throws, on each side of doors installed across the haulage road, and along the haulage roads generally at 60-foot intervals, especially where insufficient clearance is provided.

An electric hoist is installed on the main haulageway near the old 7 left panel in No. 2 bed. This single-drum hoist is equipped with a 150-h.p., 440-volt alternating-current motor, and a 1⅛-inch rope. The hoist appears to be well installed and is equipped with a good brake. All wiring is reasonably well installed. The frame of the motor is not grounded, a signal code is not posted, and the flexible coupling is not guarded. The passageway around the hoist is under the hoisting rope and the rope is not supported at this point.

The trip-position indicator is not provided; the hoisting rope is resocketed at least every three months, and it is oiled daily with waste oil. The flanges extend at least 4 inches when all the rope is wound on the drum.

Timber and wooden planking are used extensively about this hoist installation. A number of cans of lubricating oil are stored on the wooden floor near the hoist, and spillage of oil is evident. A fire hazard is present at this installation.

A small hoist is installed at the inby end of the parting which is a short distance inby the main hoist. The hoist is equipped with a 25-h.p., 250-volt direct-current motor and is used to move trips on the parting. An endless five-eighth-inch rope is used and the hoist is operated by a push-button control located at the main hoist. The gears on the hoist are guarded, and the V-belt drive is close to the rib of the entry, but the belt is not guarded. The wiring at this hoist is supported on nails and is otherwise poorly installed. The frame of the motor is not grounded.

The ropes are inspected regularly by the hoisting engineers, but records are not kept of the inspections. The rollers on the slopes are maintained in reasonably good condition. A drag is not used on the rear of any of the trips hoisted up the slope.

Two 20-ton trolley locomotives are used for haulage on the main south slopes. Two 10-ton trolley locomotives are used for parting hauls in the long panels. Six 8-ton and one 5-ton trolley-and-cable-reel locomotives are available for use in the working panels. All are operated from the 250-volt direct-current circuit.

Headlights are in good condition, and the locomotives appear to be well maintained. The two large locomotives are equipped with compressed-air whistles, but the other locomotives do not have warning devices of any kind.

Single-conductor rubber-covered cables are used on the locomotives which are equipped with cable reels. The hook-type nips used on the cables are not fitted with fuses.

One hundred seventy-five end-dump-type steel mine cars are used. The cars hold about 3 tons of coal and are reasonably dust tight; they are equipped with brakes, and the brakes appear to be in good working order. Link-and-pin couplings are used, but they are not heat-treated at regular intervals.

Electric lights are installed at the hoists, along the partings, and at irregular intervals along the haulageways. Additional lights are needed, especially at partings, switches, and doors. The 50-watt electric lamps in use are connected to the trolley circuit. Trip lights or markers are not used on the front or rear of any moving trips.

Mine cars standing on room sidings or partings are blocked with wooden "scotches," and the brakes on the cars are set.

A man-trip comprised of a number of low wooden mine cars securely connected together is used to transport the employees into and out of the mine. The man-trip is pulled or hoisted at a reasonable speed and an official is in charge.

Employees are in the habit of jumping on or off the man-trip before it comes to a full stop. This is a dangerous practice. A tool car is not provided, and a few men were observed taking picks into the man-trip cars. Explosives or other supplies are not hauled on the man-trip.

The power is not cut off and the trolley wire is not guarded at the man-trip loading and unloading stations. Men ride on both sides of the cars, but the contact hazard would be slight if the power was cut off the trolley wire and the wire was guarded at loading and unloading stations. Men ride in the car next to the locomotive.

The locomotive which handles the man-trip to and from the 1 west parting in No. 3 bed is left on the outby end of the man-trip when it is hoisted to the outside and lowered into the mine. This is done to prevent the first car from being pulled off the track when passing around curves. The trolley pole is disengaged from the trolley wire when the locomotive is connected to a hoisting rope. The locomotive has braking capacity sufficient to control the trip in case a rope should break. However, a safety hitching is not provided between the locomotive and the outby car.

A manway is not provided in the mine. The old manway in No. 2 bed has been abandoned and is not safe for travel.

No one other than the haulage crews was observed riding on the locomotives or trips. Haulagemen were not observed jumping on or off moving trips. Flying switches and back-poling are not permitted, but moving locomotives by "nipping" is a general practice.

Trip riders were observed running ahead of moving trips to throw switches and to open doors. This is a dangerous practice.

Empty trips are pushed from the 1 west parting to the working districts

in No. 2 bed. Short trips are handled, and the hazards are slight if reasonable precautions are taken.

The locomotives are not equipped with standard rerailers. Short rails and blocks of wood are used to rerail cars.

Haulagemen wear loosely fitting clothing. This is a hazardous practice as it increases the possibility of getting caught on projecting parts of moving equipment.

The rider on the inside trip rides on the front end of the ascending trips. This is a dangerous practice, especially when passing through the narrow rock slope. The rider on the outside trip stands either on the bumper of the rear car or between the two rear cars when the trip is hoisted to the tipple. All trip riders ride on the rear bumper of the outby car on descending trips.

On locomotive haulage the trip riders or "nippers" use whistles for signalling the motormen.

The bell-signal system at the inside hoist is operated from the 250-volt direct-current circuit. The recommended practice calls for a maximum of 24 volts on bare signal lines. Any voltage over this presents an electrical contact hazard.

Electricity Underground

Two drill holes from the surface contact the intake airway about 2,900 feet inby the mine portal. A 7-inch pipe line for discharging water from the mine is installed in one of these drill holes. The other drill hole is cased, and a metal conduit enclosing the high-voltage circuit is suspended in it. A 4-conductor lead-covered cable which provides circuits for the two telephone systems is suspended in the same drill hole.

A small wooden frame structure covered with corrugated sheet metal encloses the high voltage switches and a telephone at the top of the drill hole, on the surface. The door to this building is kept locked. Cut-outs, equipped with fuses, and lightning arresters are installed on the high-voltage line at the pole near the drill hole. One of the oil switches in the building is on the high-voltage circuit which enters the drill hole, and the other is on the high-voltage circuit extending to the Foster mine.

The voltage on the power line is 4,400 at the main transformer station but is reported to be 3,800 at the drill hole.

Power at 3,800 volts alternating current is transmitted from the drill hole to the interior of the mine through three single-conductor rubber-covered cables enclosed in a metal conduit. This conduit is laid along the floor down the intake entry in No. 2 bed to the old 13 left panel, and in the 13 left panel it extends about 2,200 feet to the airshaft or rock slope to No. 3 bed. The conduit extends down the rock slope and is laid along the floor of the left main south slope to the lower rotary converter near the 8 southeast panel. Cut-outs fitted with fuses are provided on the high-voltage circuit near the old 12 left entry in No. 2 bed and near the bottom of the rock slope. The metal conduit is not grounded except by contact with the casing in the drill hole, and there is a gap in the conduit where the cut-outs are installed.

Insulated platforms are not provided, and "High Voltage—Danger" signs are not posted at the cut-outs.

Bare feeder cables extend along the haulageways from the rotary-converter stations to the interior of the mine. All cables, trolley, and feeder wires on the 250-volt direct-current system were interconnected at the time of the inspection. Cut-out switches and circuit breakers are provided on the control panels in the rotary converter stations. The bare feeder cables and bare feeder wires are supported on nails or track spikes driven into posts. Very few insulators were observed. The bare feeder cables and wires are not guarded at any point, and many contact and fire hazards are present. Neither are the bare cables or wires insulated where they pass through wooden doors or stoppings. Evidences of current leakage are apparent generally where the bare wires contact wet posts or wet coal surfaces. Bare feeder wires in some rooms extend beyond the last crosscut, and cut-out switches are not provided at the room necks.

All booster fans are operated continuously, and, as the No. 3 fan is driven by a direct-current motor, it is necessary to operate one rotary converter 24 hours each day. The direct-current feeder and trolley wires were all interconnected at the time of this inspection, and this practice kept the entire system energized. The management has stated since that cut-out switches have been installed to provide a means of cutting off the power from wires not needed for the operation of the fan.

Trolley wires are supported on hangers, but the insulated bases of many hangers are missing. The wires are installed about 6 inches outside of, and about 5 to 6½ feet above, the rail. Guards are not placed on the trolley wires at any point. Trolley frogs are not provided at all turnouts.

Feeder-wire extensions from the trolley circuit are made by twisting one end of the bare feeder wire about a hanger.

The terminals of trolley wire and feeder cables are cut off and anchored with insulated turnbuckles.

Only one rail is bonded along the haulageways, and very few cross bonds are installed. The track in rooms is not bonded.

Six telephones are installed underground as follows: 1 at the hoist, 1 at the centrifugal pump, 2 on the 1 west parting, and 2 in the underground shop. One of the telephones in the shop is on the public telephone circuit, which is maintained in the mine. Fuses are installed on both telephone circuits at the bottom of the drill hole, but lightning arresters are not provided on the circuits above ground. The metal cases of the telephones are not grounded, and insulated platforms are not provided in front of the telephones.

Transformers used in the mine are installed in the open. One set of three 15-kw. 3,800- to 440-volt oil-filled transformers is installed on a concrete base in a crosscut below the hoist. The three rubber-insulated conductors extend from the high-voltage circuit in the intake airway to the transformers. These wires are on the floor in under a cave and are not otherwise supported on insulators.

Four oil-filled transformers are installed near the triplex pump in the old "runaround" entry below 8 right panel. Two 10- and one 15-kv.a. 3,800- to 220-volt transformers provide power at the reduced voltage for the pump. One 100-kv.-a. transformer installed here reduces the voltage on the power from 3,800 to 220 volts for operating the No. 1 booster fan which is inby this point. The wiring at these transformers is well installed, but the feeder wires extending to the fan are laid along the floor. The casings of the transformers are not grounded.

Five rotary-converter installations are maintained in the mine. Each installation is as follows:

One 198-volt a.-c. to 275-volt d.-c. 150-kw. rotary converter.

Three large, oil-filled 3,800- to 198-volt transformers.

The high-voltage wires are in conduit.

An insulated platform is used in front of the high-voltage switch.

The frames of the equipment are not grounded.

"High Voltage—Danger" signs are not posted.

Two of the installations are near the 3 west panel, and two are near the 5 west panel. These installations are in open cross-cuts off the main south haulageway. Three small transformers are placed near the installation on the left side opposite to 5 west panel for reducing the voltage of the power from 3,800 to 220 volts, for operating the No. 2 booster fan, which is in the 8 southeast back entry. The installation near the old 7 right panel in No. 2 bed is in the old substation which is partially enclosed. Cut-out switches and hand-operated circuit breakers are provided on the switchboards at the installations.

Three track-mounted coal-cutting machines are in use. One universal cutting-and-shearing machine, and one arcwall or top-cutting machine have 9-foot cutter bars. One shearing machine is used and it has an 11-foot cutter bar. All operate from the 250-volt direct-current circuit.

These nonpermissible machines are of an enclosed type, but the covers have been removed from the housings over some of the electrical parts. Otherwise, the machines appear to be in reasonably good operating condition. The single-conductor rubber-covered cables used on these machines are fitted with hook-type nips, and the machines are frequently moved by "nipping." Fuses cannot be used with the type of nips in use. Splices on the cables appear to be well made. The equipment and cables are inspected regularly by a mechanic, but records are not kept of the inspections.

Two main pumps are installed in the "runaround" entry below the 8 right panel in No. 2 bed. One is a triplex plunger pump equipped with a 30-h.p., 220-volt motor. The gears on this pump are guarded, but the V-belt drive is not. An enclosed switch is used. The wiring about the pump is in need of overhauling. The other is a centrifugal pump operated by a 100-h.p., 2,200-volt motor. An insulated platform is placed at the high-voltage switch, and a "High Voltage—Danger" sign is posted. The starting compensator for this pump is in an oil-soaked wooden box attached to a post. Wiring at this pump was disarranged at the time of the inspection, as the motor had just been installed. The frame of the starting switch is grounded.

A small plunger pump driven by a 5-h.p., 250-volt direct-current motor is installed at each of the following points; on the haulageway, 2,500 feet inby the portal; in 4 west panel; 8 west panel; 8 southeast panel; and 4 east panel. Open switches are used; all belts need guarding, and exposed gears need guarding on the pumps in the 4 east panel, 5 west panel, and the one on the haulageway. Wiring at these pumps is good, except at the one in 4 west panel where uninsulated wires are used.

One small centrifugal pump, connected direct to a 5-h.p., 250-volt direct-current motor, is installed in the No. 1 coal bed near the shaft to the surface. The bottom of this shaft is just off the haulage road and is about 2,600 feet inby the portal. Wiring from No. 2 bed up to this pump is very poorly installed, and an open switch is used at the pump. Water is pumped from a sump in the limited workings of No. 1 bed and discharged out of the mine.

The triplex pump discharges water from a nearby sump through an 8-inch drill hole to the surface. This drill hole is near the pump. The centrifugal pump discharges water from the sump out through the 7-inch drill hole to the surface. A pipeline from the pumps in No. 3 bed extends to the sump. This pipeline is made up of 2-inch pipe mostly, but some 2½-inch pipe is used.

Three track-mounted and three tractor-mounted mobile mechanical loading machines are maintained. One of the tractor-mounted machines is idle. The machines are of the enclosed type, but covers are missing from the housings over electrical parts. Otherwise, the machines appear to be in good condition. Cables on the track-mounted machines are the same as those used on the coal-cutting machines. Two-conductor cables are used on the tractor-mounted machines, otherwise, the cables are the same.

A 7-man crew is employed with each track-mounted loading machine, as follows: 1 operator, 1 helper, 1 face man, 2 trackmen, and 2 haulagemen. About 350 tons of coal is loaded in a 7-hour shift.

A 6-man crew is employed with each tractor-mounted machine, as follows: 1 operator, 1 helper, 1 faceman, 1 trackman, and 2 haulagemen. About 160 tons of coal is loaded in a 7-hour shift.

Coal for the 5 operating mechanical loaders is cut by 6 machine men on each shift, and the coal is drilled and blasted by 4 men on each shift.

The roof is tested frequently by men on the loading crews. Bars or picks are used for this purpose.

Electric drills have been mounted on small haulage locomotives to make mobile drilling machines. Two of these machines are in use.

A truck-mounted air compressor is used in the 4 west panel where an entry is being driven across a fault. The compressor is equipped with a 25-h.p., 250 volt direct-current motor. The belt and the open-type controller need to be guarded. Men operating the percussion drills are furnished respirators by the company.

An underground repair shop is maintained in a crosscut off the main south entry, below the 3 west panel. Acetylene- and arc-welding equipment is used

in the shop. Mechanics wear colored goggles and shields when using the welding equipment. Belts on the drill presses and on the emery wheels are not guarded; the emery wheels are not shielded. The shop is kept reasonably clean.

The grounding of electrical equipment generally has been neglected. The starting compensator for the centrifugal pump operated from the 3,800-volt circuit is the only control switch in the mine at which the metal frame is grounded.

An inspection of all electrical equipment in the mine is made each week by the mine electrician, but records are not kept of the inspections.

The locations of permanent electrical installations are not shown on the mine map. Instructions in the giving of artificial respiration are not posted in or about the mine.

Fire Protection Underground

Pipe lines are maintained only from the underground pumps to the sump in No. 2 bed. Taps are not provided along this pipe line. Fire hose on the surface is available for use underground.

A 400-gallon metal tank mounted upon a truck and equipped with a small motor-driven pump is available for use in the event of a fire. A length of hose is not provided at this time, but the officials stated that hose for this tank was ordered.

Fire extinguishers of the carbon tetrachloride type are provided as follows: one of the 1½-quart extinguishers is kept on each of 2 loading machines, on the universal cutting- and shearing machine, at the hoist, and several are kept in the shop; one small extinguisher of the carbon dioxide type also is kept in the shop.

Water is always available in the mine. A reasonable supply of brattice cloth, boards, nails, and cement is kept on the surface.

Several barrels of oil were observed at each of several locations in the mine. The barrels are stored in the open entry. Small cans holding 2 to 5 gallons each are used to carry oil to the working faces. The cans have tight-fitting covers.

Fire runs are not made immediately after blasting. One rather serious fire was experienced as a result of this practice.

Protective Clothing

The mechanics in the outside shop and in the inside shop appear to wear goggles properly. Otherwise, goggles are not worn on the surface or underground. About 10 per cent of the employees on the surface and underground wear safety caps and safety shoes.

Respirators are provided by the company for all employees who will wear them.

Miscellaneous Hazards

The coal in this mine apparently is not subject to spontaneous combustion. Workings in the Smith mine are not near those of any other mine in which

water is known to exist. Workings in the old abandoned Washoe mine are near old workings in the No. 2 bed, and seepage from that mine is apparent in the Smith mine.

Openings to the mine are not exposed to flood hazards.

Tools are provided by the company and are inspected by the foreman. Faulty tools were not observed. Ax handles are used as purchased and range from 20 to 26 inches in length. A hazard exists when axes with long handles are used as single-handed tools.

Rails, timber, and ties are stored in a reasonably safe manner.

Escapeways from the mine are as follows:

1. The intake airway, in which there is a downcast airshaft or rock slope about 125 feet in length and driven at an angle of 30 degrees from the horizontal. The cross-sectional area of this slope ranges from 25 to 40 square feet. It is timbered and lagged; a short ladder and a cleated walkway are installed in it. This rock slope is being enlarged in size, according to a letter received from the management. The entrance to the intake airway is timbered with wooden crossbars.

2. The slope haulageway, which is a return airway. The entrance to this slope is timbered with wooden crossbars.

3. The upcast airshaft, or rock slope, extending from a slant off the main haulageway, just outby the hoist, for about 100 feet up to No. 1 bed, and thence about 200 feet to the surface. This rock slope is driven on an angle of 30 degrees from the horizontal. The outby end of this slope is timbered with 4-piece wooden square sets, but the section between the coal beds is not timbered. The outby section can be traveled easily, but the section between coal beds has not been graded and is very difficult to travel.

The rock slope from the 4 east panel in No. 3 bed up to the No. 2 bed cannot be considered as an escapeway as the old entries in No. 2 bed are caved and are not safe to travel. Likewise, the connection from the top of this shaft out through the old Foster mine to the surface is not safe for travel.

GENERAL SAFETY CONDITIONS

Supervision and Discipline

The two foremen on the day shift supervise a total of 77 employees, and the one foreman on the night shift supervises 64 employees. It is evident that such a small supervisory force cannot look after the operation of a mine of this size and have time to examine the airways and the adjacent workings occasionally. Conditions in the mine as disclosed by this inspection indicate that additional supervisory officials are needed. Discipline in the mine appears to be fair.

Officials are not required to do other than supervisory work.

The mine foreman and fire bosses have certificates of competency issued by the Board of Examiners serving under the Industrial Accident Board of Montana.

Safety Organization

A safety organization is not maintained. One of the employees is designated as a "safety man" whose duty it is to go about the mine and report any unsafe conditions discovered. This man is not certified as a mine official.

Safety Rules and Standards

A definite set of rules or standards covering the operation of the mine has not been compiled.

Safety Meetings

Safety meetings of any kind are not held.

Bulletin Boards

A large bulletin board is provided in the mine office, and several small ones are attached to the outside of the mine-office building. Safety bulletins are not provided.

First Aid and Mine Rescue

About 11 men were trained in first aid in October of 1942, and 9 men were trained in mine-rescue work in 1930.

First-aid supplies in the mine are limited to 4 blankets, 2 stretchers, and a small quantity of dressing materials. On the surface, 4 blankets, 2 stretchers, and 2 hospital beds fitted with canvas-covered mattresses are kept in the first-aid room.

The nearest hospital is in Red Lodge, 7 miles from the mine.

Five 2-hour self-contained oxygen-breathing apparatus, and the necessary pump and tools to maintain them, are kept in one of the supply houses, but this equipment has neither been used nor maintained for a number of years.

Two all-service gas masks are available, but only one sealed and one unsealed canister are on hand. The management stated that similar gas masks and a supply of canisters are maintained by the Red Lodge Fire Department, and that this equipment is available for use at the mine.

None of the employees has a self rescuer.

The mine does not have access to a joint-or state-owned rescue station.

Accident Statistics

The foremen investigate and report on any accidents occurring during their shifts. A committee from the local union investigates each serious accident and makes recommendations to the company when unsafe conditions are found.

The accident experience at this mine for the years 1938 to 1941, and for the first 10 months of 1942, is set forth in Table No. 3.

One fatal injury was incurred in 1938 as a result of a fall of top coal and rock. The fatal injury in 1941 resulted from the falling over of a newly constructed concrete wall. The serious injury in 1942 resulted when an employee

fell into moving machinery on the tipple, and his leg was so badly injured it was necessary to amputate it. With the exception of these three injuries, the accident frequency and severity rates for this mine do not compare unfavorably with the average rates for all bituminous coal mines.

Good supervision, and the correction of unsafe conditions and practices, should result in an improvement in the accident experience at this mine.

TABLE NO. III

Cause	1938		1939		1940		1941		1942	
	Number of Injuries	Days Lost Time	Number of Injuries	Days Lost Time	Number of Injuries	Days Lost Time	Number of Injuries	Days Lost Time	Number of Injuries	Days Lost Time
Inside—										
Falls of rock or coal	*5	6,160	3	61	2	758	2	62	2	190
Transportation	4	337	3	103	2	116	5	232	4	420
Handling Material	....	.....	2	40	7	196	4	107	7	128
Electricity	....	.....	....	....	....	.....	....	.....	1	1
Hand Tools	2	68	1	27	....	.....	1	15	2	15
Machinery	1	66	2	32	1	4	....	....	1	3
Slipped and Fell	1	107	....	....	1	9	3	53	1	10
Flying Objects	....	.....	3	8	1	22	3	53	1	1
Nails	1	3	....	....	....	.....	....	....	....	190
Miscellaneous	....	.....	....	....	1	908	....	....	....	.....
Total	14	6,741	14	271	15	1,923	18	522	19	768
Outside—										
Falling wall	....	.....	....	....	....	.....	*1	6,000	....	.....
Transportation	....	.....	1	29	3	83	2	14	3	194
Handling Material	1	55	1	3	....	.....	....	....	1	20
Slipped and Fell	1	30	4	278	....	.....	....	....	....	.....
Hand Tools	....	.....	1	2	....	.....	....	....	....	.....
Machinery	....	.....	....	....	1	5	....	....	1	3,000
Miscellaneous	....	.....	1	8	....	.....	....	....	....	.....
Total	2	85	8	320	4	88	3	6,014	4	3,214
TOTALS	16	6,826	22	591	19	2,011	21	6,536	24	3,982

* Includes 1 fatal.

	1938	1939	1940	1941	10 Mos. 1942
Total of all injuries	16	22	19	21	24
Total severity charge	6,826	591	2,011	6,536	3,982
Total man-hours worked	247,373	259,235	276,049	289,387	305,930
Man-hours worked per injury	15,461	11,783	14,528	13,780	12,747
Total tonnage of coal	277,590	318,323	320,457	352,124	329,670
Tons produced per injury	17,349	14,469	16,866	16,768	13.736
Frequency rate	64.68	84.87	68.83	72.57	78.45
Severity rate	27.59	2.28	7.28	22.59	13.02

Frequency rate is the number of lost-time injuries per 1,000,000 man-hours worked.

Severity rate is the number of days lost time per 1,000 man-hours worked.

Summary of Safety Conditions

The management and officials are to be commended for establishing the practice of top cutting the coal and avoiding the disturbing of the unsound roof; they also are to be commended for their receptive attitude toward suggestions made during this inspection.

RECOMMENDATIONS

After careful consideration, the following recommendations are suggested as a means of minimizing, or correcting, such practices and conditions as are considered to be unsafe. In studying the recommendations it becomes evident that some of them should be given immediate attention in order to combat certain hazards. The recommendations which should receive first attention are marked with an asterisk (*). The remaining recommendations should be carried out along with the above group, insofar as is possible; and within a reasonable period, all of the recommendations should be complied with, but, until complied with, cognizance should be given to the hazards involved and precautions taken to minimize the risks.

One or more of the recommendations perhaps may differ from some provision of the mining law or safety order of the State of Montana. The intent is not to advocate noncompliance with State law, but to suggest that it may be desirable for the coal mining industry to examine into such variations and determine whether modification of the law or order may be beneficial.

Tipple

*1. All wiring on the tipple should be installed in conduit or upon insulators.

*2. Dust-tight covers should be provided for the open-type motors in the tipple and in the small-coal structure. Preferably, enclosed-type motors should be used.

*3. The frames of all electric motors should be grounded.

*4. Enclosed switches should be used to control all electrical equipment.

*5. The tipple should be cleaned some daily and thoroughly at least one each week.

*6. Water should be piped onto the tipple, and sprays should be installed at points where coal dust is made. The sprays should be used when weather conditions will permit.

*7. Handrails should be installed on the stairway at the ground level near the railroad tracks.

*8. Approaches should be provided to the points where machinery is oiled or greased and to the platforms on which the "bony" pickers stand while working.

*9. Guards should be provided over all exposed moving parts of mechanical, gear, and belt installations.

*10. Signs warning of insufficient clearance should be posted on the tipple and trestle bents near the railroad tracks. Workmen should be warned frequently as to this hazard.

Surface Haulage

1. All frogs, guardrails, and lead rails should be blocked.

2. All switch throws purchased in the future should be of the parallel type.

*3. Openings in the flooring of the trestle should be covered, and loose guardrail along the west side should be repaired.

4. Workmen should wear safety belts when dropping railroad cars.

*5. Warning signs should be placed on both sides of the "runaround" track near the domestic coal bin.

Hoisting Equipment

*1. A standard signal code should be posted at the main hoist.

2. Positive devices to prevent overwinding and overspeeding should be installed on the main hoist.

3. Hoisting engineers on the surface and underground should undergo a physical examination at least annually, and the physicians' reports should be posted near the hoists.

4. A second engineer should be present at the hoist when man-trips are being hoisted or lowered. This applies to the underground as well as the surface hoist.

5. A record should be kept of the daily inspections made of the hoist and rope.

*6. The enclosure for the hoisting engineer, inside the hoist house, should be constructed of fireproof materials.

7. An enclosed switch should be provided for the 440-volt circuit at the hoist. An insulated platform, or rubber mat, should be placed on the floor at the switch.

*8. The frame of the hoist motor should be grounded.

*9. The flexible coupling on the hoist should be guarded, and set screws of the proper length should be provided on the shaft collar.

*10. A guard should be placed over the exposed gears on the small snubbing hoist, and the resistance coils should be shielded to remove the contact hazard.

*11. Power on the bell-signal systems on the rope-haulage roads inside and outside of the mine should not exceed 24 volts.

Steam Plant

1. A guard should be placed over the gears at the top of the coal elevator.

2. Machinery and parts stored in the shed at the front should be piled neatly.

Surface Transformer Stations

*1. A fence at least 6 feet high should be placed about the main transformer station, and a gate should be provided and kept locked except when opened by authorized persons.

2. A fireproof building should be provided to enclose the high-voltage switches which control the mine circuits.

3. Transformers within 15 feet of the ground should be enclosed by a fence at least 6 feet high, and a gate should be provided in the fence. The gate should be kept locked, except when opened by authorized persons.

*4. The casings of all transformers should be grounded.

*5. An insulated platform should be provided on the ground below the cut-outs at the transformer installation north of the washery.

Substation

1. When the new substation is completed, the frames of electrical equipment should be grounded, enclosed electric switches should be used, and insulated platforms should be placed on the floor at the switches.

Surface Power and Trolley Lines

1. Trolley wires less than 6½ feet above the rail should be guarded.

Shops

*1. Guards should be provided as follows: Over the grinding wheels of one double emery wheel, and over one wheel of another; at all belts; over the front of the old control panel for the lathe motor; at the flywheel on the air compressor; and over the blade of the circular bench saw.

*2. The ladder used in the shop should be equipped with nonskid shoes.

3. The motor which drives the air compressor should be cleaned up.

4. The barrel of compressor oil should be stored in an oil house.

5. Any gasoline kept about the shops should be stored in approved-type containers. Other gasoline should be stored in a fireproof enclosure, separate from oils, greases, or other inflammable materials.

6. The double emery wheel and the belt drives in the blacksmith and car-repair shop should be guarded.

Fan and Fan House

1. The fan should be offset at least 25 feet from the projected line of the mine opening, and explosion doors should be provided in line with the mine opening.

*2. A guard should be placed over the V-belt drive.

3. An auxiliary source of power, preferably an internal combustion engine should be provided for the fan.

4. The direction of the air flow should be changed for a few minutes at regular intervals to insure that the reversing doors are in working order. This should be done on idle days.

*5. A pressure-recording gage should be provided at the fan.

6. Devices should be provided to give warning and shut off the mine power in case the fan should slow down or stop.

*7. A guard made of wire mesh should be placed over the intake opening to the fan casing.

8. An independent electrical circuit should be installed to operate the fan.

Explosives-Storage Magazines

1. A new explosive-storage magazine should be constructed in accordance with sections 1 and 2 of the Instructions for Storing, Handling, and Transporting Explosives compiled under provision of the Federal Explosives Act.

2. The door to the detonator-storage magazine should be covered on the outside with sheet metal at least 14 gage in thickness.

3. The ventilators on the detonator-storage magazine should be screened.

4. Other materials should not be stored with the detonators. Explosives should be stored in a properly constructed and located magazine.

5. Covers should be kept on the small metal boxes of detonators. Caps and fuse made up for shooting should be destroyed if not used within a few days after being prepared.

Wash House

1. Preferably, toilet facilities should be provided adjoining the wash house.

2. Disinfectant foot baths should be placed at the entrances to all shower rooms, and the disinfectant solution in them should be changed daily.

*3. The radiator on the wall of the small shower room in the shop should be guarded.

Supply House

1. Electrical equipment and supplies stored in the small warehouse west of the mine office should be piled neatly.

Lamp House

*1. A number of permissible flame safety lamps should be provided so that each foreman, each fire boss, and each shot-firer can have one.

2. A cabinet should be provided in which to test the flame safety lamps.

*3. Naphtha should be kept in a small approved-type container. Naphtha otherwise should be stored with gasoline in a fireproof structure, separate from other buildings.

Other Buildings

1. The chain and belt drives on the elevator at the sand house should be guarded.

Surface Fire Protection

*1. Precautions should be taken to prevent a possible fire on the trestle from extending to the mine .

2. All fire-fighting equipment should be inspected and tested at least every 6 months, and records should be kept on these inspections.

3. A fire-fighting organization should be maintained.

4. A fireproof structure should be provided for the storage of oil.

*5. "No Smoking" signs should be posted at the oil house.

6. An effort should be made to make the new tipple structure as fireproof as is reasonably possible. Fire hazards in the present structure should be studied, and efforts be made to minimize them.

Checking System

*1. Each employee working underground should be issued a life check at the beginning of the shift, and the life check should be returned to the check house and placed on the check board at the end of the shift. A record should be kept of each check as it is issued.

System of Mining

1. Crosscuts between entries and between rooms should be driven every 80 feet, or less.

Timbering

*1. Posts should be set as close to the faces as is practicable, considering the type of loading equipment in use.

2. Prepared cap pieces and wedges should be provided.

Explosives and Blasting

*1. Only sufficient explosives to last one day, including any surplus remaining from the previous day, should be taken underground.

*2. When the explosives car is transported by trolley locomotive, at least two empty cars should be placed between the locomotive and the explosives car. An insulated coupling should be used between the explosives car and the first empty car.

*3. Wooden mallets and hardwood wedges should be used to open explosives cases.

*4. Explosives in canvas bags should be carried to the working faces by the shot-firers. Explosives should not be towed about the mine behind the mobile drilling machines, as is now the practice.

*5. Only permissible explosives, fired in a permissible manner, should be used for blasting coal. Black powder should not be used.

*6. Permissible gelatin explosives should be provided for blasting rock.

*7. Explosives should not be brought to the face while electrical equipment is operating in the place.

*8. Sufficient incombustible material should be used in each hole to give at least 24 inches of tamped stemming. Preferably, all holes should be tamped to the collar. Coal screenings should not be used for stemming.

*9. Wooden tamping bars should be used.

*10. Tests should be made with a flame safety lamp for gas in each place before and after blasting.

*11. Each place should be examined for fires within a reasonable period after blasting.

*12. The shot-firers should report daily in writing the number of shots fired, the quantity of explosives used, the number of blown-out or misfired shots experienced, and any unusual conditions encountered.

*13. All shots should be fired instantaneously. When permissible explosives are used, instantaneous electric detonators should be provided.

Ventilation and Gas

*1. All stoppings should be made as airtight as is reasonably possible. Stoppings between the intake and return airways should be constructed of incombustible materials.

*2. A ventilating system should be devised whereby each working panel would be ventilated by a separate split of fresh air, using overcasts where necessary, and placing all haulageways on intake air.

*3. Old caves should be cleaned up, and the intake airways in No. 2 bed enlarged in cross-sectional area. The downcast airshaft between the coal beds also should be enlarged.

*4. A railing should be placed about the top of the downcast airshaft.

*5. The volume of air reaching the working section in No. 3 bed should be increased.

*6. Line brattices should be erected in a substantial manner, and they should extend close to the faces.

7. Bratticing material should be treated so as to make it fire-resistant.

*8. Where old workings are ventilated, the return air from them should not be used to ventilate active workings.

*9. Old workings that cannot be properly ventilated and inspected should be sealed off.

*10. The direction of the air flow should be marked on the latest map, which also should be posted at the mine.

*11. Booster fans, installed in an airway through which return air from any working or idle sections of the mine is passing, should be equipped with permissible motors and enclosed switches. A fire-proof enclosure should be provided for each motor, and the fans should be set in fireproof stoppings. Preferably, the use of booster fans should be avoided.

*12. Small trap doors, installed at intervals in the stoppings between airways, should be top-hinged and self-closing.

13. All stoppings between rooms should be constructed of boards, preferably plastered on both sides, or of other fire-resistant material. Brattice-cloth stoppings should be used only in the second crosscut outby the faces.

14. The approaches to all overcasts used in the future should be graded to reduce the resistance to the flow of the air currents.

15. The use of doors across haulageways should be avoided, if possible. If used, the doors should be erected in pairs so as to form air locks. The doors should not be fitted with latches to hold them open. Each door should be provided with a small glass or transparent plastic window.

*16. Inflammable or explosive gas should not be permitted to accumulate and stay in any part of the mine. When an accumulation is discovered, work on the return side of the body of gas should be discontinued until the gas is removed properly by improved ventilation. A certified official should supervise directly the removing of bodies of gas.

*17. The percentage of inflammable gas in the immediate return from any working section should not be permitted to exceed 0.50 per cent. Additional air should be provided whenever the gassy content of the air approaches 0.50 per cent.

*18. Inspections for gas should be thorough; all places in which gas is found should be recorded daily in the fire bosses' report book; the mine foremen should sign the fire bosses' reports at the beginning of each shift to show that they are aware of the dangers reported, and again at the end of the shift, together with a statement of what has been done to take care of the dangers reported.

*19. The mine foremen should carry permissible flame safety lamps with them at all times while in the mine, and they should test for gas in each place visited.

*20. The mine foreman, or a qualified assistant, should examine all airways and old workings open to the ventilating current at least once each week. He also should measure the ventilating current in the main intake and main return airways, and at the intake, return, and last crosscut of each working panel. The results of this examination and the air readings taken, should be entered in ink in a record book provided for the purpose.

21. Samples should be collected monthly and analyzed of the air exhausted from the mine.

*22. Any accumulations of gas discovered should be effectively fenced off well outby the body of gas. All approaches should be blocked to the place in which a body of gas is present.

*23. All electrical equipment used in the face regions should be of a permissible type. Until such equipment is available, enclosed-type equipment should be kept in good repair, and all electrical parts should be enclosed with tight-fitting covers.

*24. Permissible electric cap lamps only should be used by workmen employed underground. Open lights should not be permitted in the mine.

*25. Smoking should not be permitted in the mine, and workmen should be searched frequently for matches and smoking materials.

*26. Only permissible flame safety lamps should be used.

Dust

1. Coal should not be used for ballasting tracks.

2. Coal spillage along the haulage roads should be cleaned up and removed from the mine.

3. Water should be piped to all working places, and it should be used on the cutter bars while coal is being cut, in the face regions before and after blasting, and on the coal as it is loaded.

*4. Rock dust should be applied to all dry surfaces in the mine to within at least 40 feet of the faces. The rock dust should be applied in sufficient quantity to raise the incombustible content of the mixed coal and rock dust to at least 65 per cent.

5. Men employed in dusty operations should wear the approved-type respirators provided for them.

Haulage Underground

*1. Refuse and road cleanings piled along the ribs of the haulageways should be loaded up and removed from the mine. Some of the sloughing rib coal also should be removed.

*2. All switches should be provided with throws, preferably of the parallel type.

3. All frogs, guardrails, and lead rails should be blocked to remove the hazard of workmen getting their feet caught.

*4. A clearance of at least 30 inches between haulage equipment and the rib or other obstructions should be provided along one side of all haulageways. At least 12 inches of clearance should be provided between haulage equipment and the rib on the "tight" side of all haulageways.

5. Signs calling attention to the lack of clearance should be posted at partings and also at each end of the rock slope between the coal beds.

6. Shelter holes 60 feet apart should be provided along the clearance side of all haulageways. First attention should be given to providing shelter holes for several hundred feet inby the mine portal, along the rock slope between coal beds, at switch throws, and on each side of doors on the haulageways.

*7. The frame of the motor on the main hoist should be grounded, a standard signal code should be posted, and the flexible coupling should be guarded.

*8. A support for the main rope should be provided over the passageway to the hoist.

*9. The roof supports and flooring about the hoist installation should be made as fireproof as is reasonably possible. Oil spillage should be cleaned up.

*10. The V-belt drive on the small hoist should be guarded, the wiring should be installed properly on insulators, and the frame of the motor should be grounded.

11. A record should be kept of inspections made of the hoists and ropes.

12. A drag should be used on the rear of all trips pulled by electric hoists, and on the rear of all trips pulled by locomotives on grades of 3 per cent or more.

*13. All locomotives should be provided with warning devices.

14. Link-and-pin couplings should be heat-treated at least annually to reduce the possibility of breakage caused by crystallization.

*15. Additional electric lights should be provided at partings, switches, and on both sides of doors.

*16. Permissible electric trip lights should be used on the rear of all trips pulled and on the front of all trips lowered by hoists or pushed by locomotives.

*17. Sprags should be placed in the wheels of standing cars, regardless of the grade.

*18. Men should not enter or leave the man-trip until it has come to a full stop.

*19. Tools should not be carried in the man-trip cars with the men. A tool car should be provided.

*20. Provision should be made to cut off the power when men are entering or leaving the man-trip. This applies to loading and unloading stations on the surface and underground.

*21. The trolley wire should be guarded at man-trip loading and unloading stations, on the surface and underground.

22. Men should not ride in the car next to the trolley locomotive when the locomotive is pulling the trip.

*23. A safety hitching should be provided between the locomotive and the first car of the man-trip.

*24. Haulagemen should not move locomotives by "nipping."

*25. Trip riders should not run ahead of moving trips to throw switches or open doors. The trips should be stopped at such times.

26. All locomotives should be equipped with standard rerailers.

*27. Haulagemen should wear snugly fitting clothing, keep their cap lamp cords under their jackets, and confine the legs of their trousers.

*28. The trip rider should not ride on the front bumper of the trip hoisted through the rock slope.

Electricity Underground

*1. The metal conduit, housing the high-voltage circuit, should be maintained electrically continuous, and it should be grounded at intervals.

*2. Insulated platforms should be provided at all electrical switches, other than cut-out switches on the trolley circuit, inside the mine.

*3. "High Voltage—Danger" signs should be posted at all high-voltage switches and equipment installations.

*4. Sectional switches should be provided on the direct-current system so that electric power can be cut off any part of the mine.

*5. All bare feeder cables and wires should be installed on insulators and kept from contacting posts, stoppings, and coal surfaces. The wires should be insulated where they pass through stoppings or door frames.

*6. Bare feeder cables and wires, less than 6½ feet above the rail, should be guarded at crossings and for 16 feet on each side of all doors.

*7. Cut-out switches should be installed on the bare feeder wires at the entrances to all rooms, and the wires should not be extended beyond the last crosscut between rooms and between entries.

*8. Trolley wires should be supported on insulated hangers.

9. All trolley wires less than 6½ feet above the rail should be guarded for the entire length.

*10. Frogs should be installed on the trolley wire at all turnouts.

*11. Proper attachments should be provided for connecting the feeder wires to the trolley circuit.

*12. Both rails should be bonded of all track serving as a return for the direct-current circuit. Cross bonds should be installed at switches and every 200 feet along all bonded track.

*13. Lightning arresters and ground wires should be installed on the telephone circuits near the drill hole on the surface.

*14. The metal case should be grounded, an insulated platform should be provided, and fuses should be installed in the circuit, at each telephone.

*15. The high-voltage circuit to the transformers below the hoist should be placed in conduit.

*16. The 220-volt circuit from the transformers to the No. 1 booster fan should be installed upon insulators attached to posts.

*17. The casings of all transformers should be grounded.

18. Transformers and rotary converters should be installed in fireproof enclosures fitted with doors that will close automatically in case of fire inside the station.

*19. The frames of all direct-current generating equipment should be grounded.

20. Nips fitted with fuses should be used on all trailing cables.

21. A record should be kept of all inspections made of electrical and mechanical equipment.

*22. The V-belt drive on the large triplex pump should be guarded.

*23. The wiring at the large plunger pump should be overhauled and installed in a workmanlike manner.

*24. The starting compensator for the large centrifugal pump should be placed in a fireproof box. Oil leakage from the compensator should be thoroughly removed frequently.

*25. The belt-drives on all small plunger pumps should be guarded.

*26. Exposed gears should be guarded on the small plunger pumps in the 4 east panel, 5 west panel, and the one on the haulageway.

*27. Insulated wires should be used on the circuit to the pump in the 4 west panel.

*28. The 250-volt circuit to the pump in No. 1 bed, near the upcast shaft to the surface, should be properly installed on insulators.

29. Enclosed switches should be used to control equipment operated from any of the electrical circuits.

*30. The belt and the open-type controller on the small air compressor should be guarded. An enclosed controller should be provided as soon as is reasonably possible.

*31. Electric or acetylene welding should be permitted only in pure intake air, and proper precautions should be taken against fire.

32. Belts should be guarded on machinery in the shop.

33. The emery wheels should be properly guarded.

34. The metal frames of all electrical switches should be grounded.

35. The locations of all permanent electrical installations should be shown on the mine map.

36. Instructions in the giving of artificial respiration should be posted in and about the mine.

Fire Protection Underground

1. Taps for use in case of fire should be provided at intervals along pipelines.

2. Fire extinguishers of a type suitable for use on electrical fires should be provided at all rotary-converter stations and on all mobile electrical equipment.

3. A few sacks of rock dust should be placed at a number of points about the mine for use in case of fire.

4. Preferably, oil should not be taken into the mine in barrels. However, if this is done, the barrels should be stored in fireproof enclosures and not more than one barrel of each kind used should be taken into a section. To reduce the hazard present in the storing of oil, only a sufficient quantity to last one day should be taken into the mine.

Protective Clothing

1. All workmen on the surface and underground should wear goggles, preferably at all times while at work, but at least while doing work that is hazardous to the eyes.

2. All employees should wear safety shoes; those working underground and those working in and about the tipple should wear safety caps.

Miscellaneous Hazards

*1. Ax handles should not exceed 18 inches in length.

2. A stairway should be installed in the downcast rock slope or shaft which extends down to No. 3 bed, and also in the upcast shaft between Nos. 2 and 1 beds.

3. When the new rock slope is completed from No. 3 bed to the surface, in the 5 southeast panel, a suitable stairway should be provided.

Supervision and Discipline

*1. Additional supervisory officials are needed on each of the two shifts worked.

Safety Organization

1. A safety organization should be established, and meetings should be held each month.

2. A safety engineer should be employed to make inspections of the mine and carry on a general safety training program.

Bulletin Boards

1. Bulletin boards of suitable size should be placed where all employees can see them, and appropriate safety posters should be provided.

First Aid and Mine Rescue

1. All employees should be trained in first aid at least annually.

2. At least two mine-rescue crews should be maintained, and the crews should receive additional training monthly.

3. Additional first-aid supplies should be provided at each of several sections underground and also on the surface.

4. The mine-rescue apparatus should be placed in operating condition, and it should be inspected and tested each month.

5. At least six all-service gas masks and 25 canisters should be kept at the mine.

6. All underground employees should have self-rescuers, and the employees should be trained in their care and use.

ACKNOWLEDGEMENT

The inspectors were afforded cooperation in conducting the inspection, and data requested were given promptly and fully. Those contacted willingly assisted in the study, but especial acknowledgement is given to the assistance of Elmer Price, mine foreman.

Respectfully submitted,

Signed: G. O. ARNOLD, Inspector.
Signed: M. R. EVANS, Inspector.

APPROVED:
Signed: E. H. DENNY, Chief Coal Mine Inspection Division.
Signed: D. HARRINGTON, Chief Health and Safety Service.

FINAL REPORT OF MINE EXPLOSION

Smith Mine, Montana Coal & Iron Company

Washoe, Carbon County, Montana

February 27, 1943

By

G. O. ARNOLD, Senior Coal Mine Inspector

M. C. MC CALL, Mining Engineer

F. J. BAILEY, Senior Mining Engineer

UNITED STATES

DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

INTRODUCTION

An explosion occurred at this mine about 9:30 a. m., February 27, 1943. Seventy-seven men were underground at the time; seventy-four men died in the explosion, and three men were rescued. The three rescued men were along the haulageway in No. 2 bed, outby and above the workings in No. 3 bed, at the time of the explosion; these men have not fully recovered from shock and exposure to noxious gases.

The cause of the explosion, as determined by the Bureau of Mines' investigating party, is thought to have been an ignition of explosive gas by a miner wearing an open light in No. 5 room off the 9 southeast entry in No. 3 bed.

The explosion was confined to the workings in No. 3 bed, and evidences of force and heat were found in about two-thirds of the workings. Propagation of the explosion was made possible by the presence of coal dust throughout the mine, and there was evidence of gas having burned in many places. The explosion was violent only in parts of the mine, and property damage was limited to the destruction of three booster fans, nearly all stoppings and doors (which were constructed of wood) in No. 3 bed, some damage to haulage locomotives and rotary-converter stations, and to the derangement of trolley and power wires.

According to the locations where the bodies were found, 44 of the men moved distances ranging from 40 to 2,000 feet, and 30 were killed instantly. Several of the men who moved had been burned, but most of them apparently had not been exposed to flame or violent forces. The bodies of most of the men who were killed instantly were badly burned, and the others were burned to some extent; about seven of the bodies were mutilated as a result of th forces of the explosion.

Water apparently was being used on the cutter bars of two track-mounted cutting machines, while cutting coal, but not in conjunction with any other face operation. The mine had not been rock dusted.

Word of the explosion was transmitted about 11:45 a. m. by John L. Boardman, chairman, Bureau of Safety, Anaconda Copper Mining Company, to J. A. Johnson, engineer-in-charge of the Butte, Montana office of the Bureau of Mines. Mr. Johnson notified the Salt Lake office about 12:00 noon by telephone. Messrs. Johnson and Emery C. Olsen, together with 12 rescue men and equipment provided by the Anaconda Copper Mining Company, left Butte by Army transport plane, landed in Billings, Montana at 3:40 p. m., and were taken to the mine by Montana State Highway patrolmen, arriving at Washoe about 5:00 p. m. Messrs. Edwards F. Courtney, Phil B. Dolman, M. R. Evans, and James K. Haybell left Butte by automobile and arrived at the mine about 7:35 p. m. Messrs. Arnold, P. H. Holland, and M. C. McCall left Salt Lake City, Utah, by automobile at 3:30 p. m. with rescue apparatus, and arrived at the mine about 11:30 a. m., February 28. Also Mr. D. F. McElhattan, district manager of the Mine Safety Appliance Company arrived about 2:00 p. m. of the same day with rescue equipment. Messrs. R. D. Reeder, Acting Supervising Engineer of the Salt Lake station, and Fred J. Bailey left Salt Lake City by automobile at 10:00 a. m. on March 2 and arrived at the mine about 9:15 a. m. on March 3. Mr. E. H. Denny, Chief, Coal Mine Inspection Division, Pittsburgh, Pa., arrived at the mine about 9:30 a. m., March 5.

Rescue men, together with equipment, also came from the Defense Chrome Account Mines at Benbow, and Moat, Montana. The State coal mine inspector, Mr. Edward Davies, a number of mine officials, and a large number of miners from near Roundup, Montana, assisted in the recovery work. Mr. Harold Graves, Chief of the Red Lodge Fire Department, took two all-service gas masks and an oxygen inhalator to the mine; he assisted in treating men effected by exposure to noxious gases.

Recovery operations, without the use of any protective equipment other than two or three all-service gas masks and a few canisters, were started by local employees immediately after the explosion. Three of the five men working near the underground hoist in No. 2 bed, about 2,600 feet inby the mine portal, were rescued, and the bodies of the other two men were recovered, between 10:30 and 11:00 a. m., or within 1½ hours after the explosion. Mr. Davies arrived early in the afternoon from Billings and entered the mine about 2:00 p. m. As the ventilating system was being repaired without suitable protective masks or oxygen breathing apparatus, and without means of testing for carbon monoxide, many of the workmen became ill, but all recovered. After the arrival of Bureau of Mines representatives with necessary protective equipment, work was started toward extending the ventilation, and the recovering of the bodies was expedited.

The first bodies from the workings in the No. 3 bed, were brought to the surface on Thursday, March 4. The last two bodies, including that of the mine foreman, Elmer Price, were brought to the surface about 6:00 p. m., Sunday, March 7.

After recovering the bodies, it was necessary to wait a week before workmen could be procured to reestablish ventilation in the mine. The work was completed on March 20, and the investigation to determine the cause and origin of the explosion was made from March 22 to 29, by the following persons:

Representing the company:
- W. A. Romek, Assistant Manager
- Tom Freeman, Outside Foreman
- Loren Newman, Mine Foreman
- Martin Rapp, Mine Foreman

Representing the United Mine Workers of America:
- W. A. Boyle, President, District 27
- Joe Masini, International Board Member
- Joe Yanchisin, District Board Member
- Joe Bosome, Secretary Local Union No. 4457

Representing State of Montana:
- Edward Davies, State Coal Mine Inspector
- Ben Henry, State Metal Mine Inspector
- Archie Browning, Mine Foreman, Giffin mine, Great Northern Railroad Company, Giffin, Montana

Representing the Bureau of Mines:
- G. O. Arnold, Senior Coal Mine Inspector
- Fred J. Bailey, Senior Mining Engineer.

GENERAL INFORMATION

An inspection was made of this mine November 19 to 30, 1942, by G. O. Arnold and M. R. Evans, (Mining Engineer, Butte, Montana) and the final report is now available for study.

Location and Operating Officials

The Smith mine is owned and operated by the Montana Coal & Iron Company. The mine is on a branch line of the Montana, Wyoming and Southern Railroad Company at Washoe, about 50 miles northeast of Laurel, Montana.

The officials of the company and their addresses are as follows:

C. R. Smith, President, Menasha, Wisconsin.

J. M. Freeman, Vice President and General Manager, Washoe, Montana.

W. A. Romek, Assistant Manager, Billings, Montana.

W. R. Freeman (resigned), Superintendent, Long Beach, Calif.

Employees and Production

Prior to the explosion, the mine was operated two 7-hour shifts and produced about 1,800 tons of coal each day; the few men employed on the third shift did such cutting, drilling, and blasting as was left over from the other shifts; two hundred forty-five men were employed as follows:

	1st Shift	2nd Shift	3rd Shift	Total
Surface	59	36	8	103
Underground	77	53	12	142
Totals	136	89	20	245

Openings

The old mine in No. 2 bed was opened by three slopes driven down in a southwesterly direction on the full pitch of the coal bed. About 3,700 feet inby the portal a rock slope was driven down to the No. 3 bed, and the workings in the No. 3 bed were developed from this point. An inside shaft was driven between the two beds, near the junction of the rock slope with the No. 3 bed, to provide the second airway. A rock slope from No. 2 bed up to the No. 1 bed and thence to the surface, and an untravelable connection with the old Foster mine in No. 2 bed are the only other openings to the surface.

Coal Bed

The mine is in the No. 3 bed of the Bear Creek coal field. Classed as subbituminous, the coal ranges from 9 to 10 feet in thickness, and dips from 3 to 10 per cent in a southwesterly direction. A maximum cover of 1,200 feet is over the workings in No. 3 bed.

A face sample was collected August 15, 1939 by a representative of the Bureau of Mines. This sample, designated as Laboratory No. B-42518, was analyzed August 31, 1939 in the laboratory of the Bureau of Mines in Pittsburgh and gave the following results:

Moisture	10.5	per cent
Volatile matter	33.6	per cent
Fixed carbon	43.1	per cent
Ash	12.8	per cent
Total	100.0	per cent
Sulphur	0.8	per cent
B. t. u.	10,490	

The ration of volatile matter to the total combustible matter as given above, $\left(\frac{\text{Volatile matter}}{\text{(Volatile matter plus fixed carbon)}}\right)$ is 0.438.

Experiments conducted by the Bureau of Mines have shown that dust from coal having a volatile to total combustible ratio of .12 is explosive, and that the explosibility increases as the ratio increases. Accordingly, dust from the coal in this bed is highly explosive and would readily initiate or propagate an explosion.

The immediate and main roof, above the 8 to 10 inches of top coal left for protection, consists of shale, or thin layers of sandy shale, which is very fragile. The floor consists of the same material and is smooth and medium hard.

UNDERGROUND MINING METHODS, CONDITIONS AND EQUIPMENT

Method of Mining

The mine was worked on the room-and-pillar method. Cross entries, in pairs, were driven right and left off the main south slopes at 300-and 400-foot intervals. Entries were driven about 14 feet wide and rooms were driven 22 feet wide. Crosscuts between rooms and between entries range from 100 to 150 feet apart. Rooms and entries were driven on 70-foot centers.

TABLE I

ANALYSIS OF AIR SAMPLES

March 26, 1943

Lab. No.	Location in Mine	Carbon Dioxide	Oxygen	Methane	Nitrogen	Cu. Ft. Air Minute	Cu. Ft. Methane 24 Hrs.
82038	Intake above 4 east	0.04	20.88	0.00	79.08	20,880	
82039	Intake above 4 east	0.05	20.92	0.00	79.03		
82040	Upcast shaft 4 east	0.30	19.70	1.36	78.64	13,600	Average
82041	Upcast shaft 4 east	0.33	19.59	1.49	78.59		279,072
82214	2 Left return, above 4 east	0.27	20.01	0.80	78.92	9,380	Average
82215	4 Left return, above 4 east	0.28	20.04	0.80	78.88		
	Total return air and methane					22,980	387,130

Above analyses made April 1, 1943 in Gas Laboratory, U. S. Bureau of Mines, Pittsburgh, Pa.

Coal is topcut and center sheared to a depth of 9 feet, and is loaded into mine cars by track-and tractor-mounted mechanical loading machines.

The top coal, left in place, make a good roof. All entries and working places were reasonably well timbered with the exception that timber usually was not set close enough to the working faces.

Pillars were not recovered in the workings in No. 3 bed.

The air is circulated by a 5-foot centrifugal fan, installed on the surface, but in direct line with the airway. Three booster fans were used underground to increase the circulation of the air and all three were destroyed in the explosion. After the explosion, the main fan was forcing 36,400 cubic feet of air per minute into the mine; at the time of the inspection in November, the fan was forcing 43,470 cubic feet of air per minute into the mine, aided by the underground booster fans.

The air was circulated through the mine in one continuous current; it passed down the west side and back out the east side, and ventilated all panels and working places. During the recovery operations, and also when the ventilation was being restored, methane was found generally throughout the mine. Progress was retarded in several panels because of the difficulty of removing the accumulations of methane.

Three sets of air samples were taken and the results are shown in Table No. 1. These samples indicate that the mine was liberating 387,130 cubic feet of methane in 24 hours on March 26, one month after the explosion. Samples collected at these same points in November indicated that the mine was liberating 409,100 cubic feet of methane in 24 hours at that time. Considering that the mine had been idle for one month, the volume of gas being liberated in 24 hours on March 26 may indicate that, with the mine in full operation, the volume of gas that would be liberated in 24 hours now might be substantially greater than the figure shown for November.

All stoppings in the No. 3 bed workings were constructed of double thickness of wood with a layer of bituminous-treated paper between, and all doors were erected singly.

Drainage

Very little water is encountered in the No. 3 bed. Several small pumps installed near swamps along the haulageways take care of all drainage.

Dust

At the time of the inspection in November the interior of the mine was generally moist, although dust was apparent throughout. The winter was cold, and the management states that the volume of air reaching the working sections had been increased, which would result in some drying out of the mine. The mine is extremely dry at this time, no doubt because of the heat of the explosion, and unusual coatings of fine dry coal dust are evident in all areas affected by the explosion.

Water apparently was being used on the cutter bars of two cutting machines, while coal was being cut, but otherwise water was not used to allay coal dust in any other operation. Rock dust has never been applied in the mine. Dust samples were not collected following the explosion, but four samples collected in November are included herein in Table No. 2.

TABLE II

ANALYSIS OF DUST SAMPLES

December 8, 1942

Lab. No.	Location in Mine	Kind of Sample	Combustible V.+F. C.	Incombustible moisture + Ash	Through 20-mesh
B-90770	5 west haulage road, inby main south	Ribs	74.1	25.9	76.2
B-90771	5 west haulage road, inby main south	Floor	53.8	46.2	66.0
B-90772	5 south east haulage road, inby main south	Ribs	74.7	25.3	74.1
B-90773	5 south east haulage road, inby main south	Floor	67.8	32.2	61.7

The above analyses were made in the Coal Analysis Laboratory, U. S. Bureau of Mines, Pittsburgh, Pa.

Haulage

Haulage from the tipple to the underground hoist in No. 2 bed is handled by the main hoist on the surface. The underground hoist was used in hoisting and lowering trips from and to the 1 west parting near the outby end of the workings in No. 3 bed. Trolley locomotives were used for all gathering and main line haulage in No. 3 bed.

Lighting

Permissible electric cap lamps were being used by some of the men. At the time of the explosion, 34 of the 77 men underground were using permissible electric cap lamps and the others were using open lights. Seventy-five permissible electric cap lamps were available for use by the 142 men employed underground.

Electric lights were installed along the haulageways, but at the time of the inspection in November additional lights were needed, especially near doors, at switches, and along partings. Trip lights or markers were not being used on moving trips.

Machinery and Electricity Underground

All electrical equipment in use underground is of a nonpermissible type. Some of the loading and cutting equipment, used near the faces, is of an enclosed type, but the protective covers over electrical parts are missing on most of the machines.

Trolley wires are reasonably well installed, although the insulated bases are missing from many hangers. Frogs are missing at some turnouts, and cut-out switches are not installed at the entrances to panels.

Bare feeder cables, supported on nails or spikes driven in posts, extend along the main haulageways. There are no cut-out switches on the direct-current distribution system, except at the rotary-converter stations. The entire system was energized when the power was on.

Bare feeder wires extend into all rooms. The wires are attached to the trolley circuit by twisting one end about the trolley wire hangers. These feeder wires extend past the last open crosscuts in most places and the wires are generally supported on nails or spikes driven into posts. Some insulators have been installed along these feeder wires since the inspection in November. Cut-out switches are not provided on these feeder wires at the entrances to rooms.

Mobile electrical equipment was moved into and out of rooms by "nipping."

Explosives and Blasting

All coal was blasted with black pellet powder; shots were fired with fuse ignited by matches or open lights. Some experiments had been made with permissible explosives, but all coal was being blasted with black pellet powder at the time of the explosion.

Fine coal, or coal dust, was being used for stemming material, and shots were being fired near the end of the shift, before the men left the mine.

Explosives were being hauled about the mine in a car attached to the mobile electric drills. Small storage boxes had been provided for storing explosives in the various sections of the mine. Some insulated bags had been provided for use in carrying explosives to the faces, but they had been used very little, and were not in general use.

One wooden tamping bar was observed which was being used to tamp holes charged with permissible explosives. Otherwise, metal tamping bars were in general use.

GENERAL SAFETY CONDITIONS

First Aid and Mine Rescue

About 11 men were trained in first aid in October of 1942, and 9 men were trained in mine-rescue work in 1930.

First-aid supplies in the mine consisted of 4 blankets, 2 stretchers, and a small quantity of dressing materials. On the surface, 4 blankets, 2 stretchers, and 2 hospital beds fitted with canvas-covered mattresses are kept in the first-aid room. Supplies and equipment inside the mine were inadequate.

Five 2-hour self-contained oxygen-breathing apparatus, and the necessary pump and tools to maintain them, are kept in one of the supply houses, but this equipment has been neither used nor maintained for a number of years.

Two all-service gas masks were kept at the mine, one underground and one on the surface. A supply of canisters was not maintained.

None of the employees had self-rescuers.

The question was asked Arnold at the Coroner's inquest as to whether any of the men might have saved themselves after the explosion, had they been equipped with self-rescuers. He replied that it is possible that all men working near the hoist in No. 2 bed might have saved themselves, but that it is highly improbable that any of the men in the No. 3 bed workings could have reached fresh air while wearing a self-rescuer. It was mentioned that the passageways through which these men would have had to travel very likely were filled with an atmosphere heated to a point where it would have been difficult to breathe, regardless of the noxious gases present.

During the recovery operations, the question was raised as to whether some of the men in the lesser affected panels might have saved themselves had they erected proper barricades. This is difficult to answer, but it does appear highly probable that some of the men could have been saved had they erected proper barricades.

Instructions in the erection of barricades are included in the standard

first-aid course. It is evident that most of the men have not received such instructions in recent years.

Emery C. Olsen, principal first aid instructor, stationed at Salt Lake City, called at the Montana Coal and Iron Company office in Washoe on September 21, 1942, and discussed the subject of first-aid training with Mr. J. M. Freeman. As a result of this discussion, Mr. Freeman wrote to the Salt Lake office requesting that classes in first aid be held at the mine. Mr. Reeder replied to this letter stating that he would take the matter up with Mr. Olsen, upon his return to Salt Lake City, October 2, and inform Mr. Freeman as to the date it would be possible for him to be there.

Mr. Olsen's itinerary was full and it was not until February 2 that an open period approached. Mr. Reeder wrote to Mr. Freeman on that day stating that Mr. Olsen would be available after February 20 to give the training.

A reply to this letter suggested that the training be postponed until late May or early June because of the men working full time and of the severe winter weather being experienced in Montana at that time.

Safety Organization

A safety organization is not maintained at the mine. One of the employees was designated as a "safety man" whose duty it was to go about the mine and report any unsafe conditions. This man was not certified as a mine official.

Supervision and Discipline

Prior to the explosion, two foremen supervised the 77 men employed on the day shift, one foreman supervised the 53 men employed on the second shift, and one foreman supervised the 12 men employed on the third shift. The foreman on the third shift examined a portion of the mine as a fire boss, in addition to his other duties. It is apparent that additional supervisory officials were needed.

According to testimony at the Coroner's inquest, April 12, 13 and 14, the four foremen employed at the mine were all on an equal status. None was in charge of the other or of the entire operation. Supervision of the entire mine was the responsibility of the mine superintendent and it would appear that he did not personally look after a very large portion of the work. One of the important needs of any mine is a competent, aggressive, mine manager or foreman, with complete charge of the entire underground operation, who will actively and personally supervise all phases of the work.

Testimony at the Coroner's inquest also indicated that one of the regular fire bosses, Mr. Newman, was taken off that job sometime in December and placed on the 11:50 p. m. to 7:00 a. m. shift as night foreman. In addition to supervising a small crew of men, Mr. Newman served as fire boss and examined a portion of the mine before the day shift entered. However, according to his testimony, he fenced off any places in which gas was found and entered the record in the fire bosses's record book, but he did not have time to clear any of the places of gas. Another fire boss was not hired to replace Mr. Newman; therefore, it would appear that the task of extending brattices and keeping all places clear of gas on the day shift, when the largest number of men was working, was left to one fire boss. This may have something to do with the gradual increase in the number of places daily in which gas was reported after December 10, which fact is discussed later in this report.

Fire-Fighting Equipment

A fire-fighting organization is not maintained. Equipment and facilities for fighting fires on the surface are unusually good.

A number of small fire extinguishers were provided underground, but the pipe lines are not equipped with taps to make water available about the mine. Fire hose on the surface is available for use underground.

None of the fire-fighting equipment is inspected at regular intervals.

Commendable Safety Practices

The final report covering the inspection made in November included this paragraph: "The management and officials are to be commended for establishing the practice of topcutting the coal and avoiding the disturbing of the unsound roof; they also are to be commended for their receptive attitude toward suggestions made during this inspection."

It was apparent from observations made during the period following the explosion that some improvements had been made since the November inspection, but, unfortunately, some unsafe practices had not been corrected, and efforts to keep the working places clear of gas were apparently relaxed shortly after the inspection was completed.

PREVIOUS EXPLOSIONS IN THIS OR NEAR-BY MINES

A gas explosion is reported to have occurred February, 1918, in the No. 3 bed workings of the old Washoe mine. This mine adjoins the Smith mine and was closed down several years ago. The ignition of the gas is reported to have been caused by an open light. Five men were burned but all recovered. Otherwise, there is no record of explosions in mines in the district.

MINE CONDITIONS PRIOR TO DISASTER

At the time of the inspection of the mine, November 19 to 30, 1942, it was apparent from a study of the fire bosses' record that gas was being reported in too many places, which in turn indicated that efforts toward keeping the ventilating current up to the working faces were either insufficient or unsuccessful. This condition was emphasized to the mine foreman and a substantial reduction was made immediately in the number of places daily in which gas was reported. Twenty-six places were recorded as containing gas at the beginning of the inspection and a minimum of eleven places was shown on November 27. According to the fire bosses' record book, the number of gassy places reported ranged up to 23 on December 4 and back down to 11 on December 9 and 10. After December 10, the number of gassy places reported, increased gradually, reaching a maximum of 30 on January 20, 21 and 22, 1943. Gas was reported in an average of 24.6 places for 10 days prior to the explosion.

The State coal mine inspector made an inspection of the mine on January 27, 1943. He reported finding gas in 5 working places and that the places were "deadlined," or fenced off. Two of the places, rooms 1 and 2 off 10 southeast entry, were not recorded in the fire bosses' book. Whether such oversights by the fire bosses' were common is not known.

After the inspection in November, certain recommendations were discussed with the management, and later with the State coal mine inspector, and these

recommendations were included in a preliminary report, one copy of which was sent December 10, 1942 to the State coal mine inspector, and two copies were sent December 10 to the management, which included one copy for posting at the mine. The most important recommendations made in the preliminary report, and steps taken to correct them prior to the explosion, are as follows:

Ventilation and Gas

1. "The intake airway should be enlarged along the narrow portions and caved material should be cleared away; the size of the intake airshaft should be substantially increased." Some clearing of the intake airway and enlarging the airshaft were accomplished. Recommendation also was made orally to the management that an airshaft or rock slope, be driven to the surface from the workings in No. 3 bed. This shaft was started between Nos. 9 and 10 rooms on the 5 southeast panel, was driven to within a few feet of the No. 2 bed, and, according to testimony at the inquest, work was temporarily stopped the latter part of January. It is unlikely that the shaft could have been completed before the explosion, had work been continued, as it was more than 400 feet from No. 2 bed to the surface.

2. "Leaky stoppings and doors should be repaired." Some work was apparently done toward remedying these defects. At the time of the inspection in November, less than half of the air entering the mine was reaching the working section. This fact was included in the preliminary report.

3. "All doors should be kept closed, except when the haulagemen and equipment are actually passing through them." Haulagemen, according to testimony at the inquest, continued to leave doors open across haulageways and brattice curtains up at the entrances to rooms.

4. "It is important that the fire bosses examine daily all workings through which the ventilating current passes before reaching the outby working places. Old workings should be examined each week." This was not being done.

5. "Explosive gas should not be permitted to accumulate and stay in any part of the mine." Accumulations of gas were apparently present for weeks in a number of places, and, according to testimony at the inquest, the ignition of gas in working places by men using open lights was a frequent occurrence.

6. "The presence of indications of gas in the air current generally outby the 7 southeast panel, makes it important that the volume of air reaching this portion of the mine be substantially increased." The management reported that the volume of air reaching this part of the mine had been increased. Air readings were not taken at the mine in such a manner that this can be substantiated.

7. "Line brattices generally should be extended closer to the working faces." According to testimony at the inquest, and observations made in the mine after the explosion, line brattices were too far back from the faces, being more than 100 feet from the face in at least one place, and averaging not less than 30 to 40 feet from the faces in most places.

8. "The use of open lights and the permitting of smoking in a mine, as apparently gassy as this mine, is highly dangerous. Smoking should be discontinued immediately and all men should be searched regularly and frequently for smoking materials. Permissible electric cap lamps should be provided for

all employees as soon as reasonably possible. Until closed lights are provided for all employees, the mine officials should see that every place in which a man with an open light works is tested with a flame safety lamp for gas before the men enter and several times thereafter during the working shift." Smoking was not discontinued. Permissible electric cap lamps were not ordered for all employees until February 8, 1943. It is apparent from testimony at the inquest that very little precaution was taken in testing for gas in places where men with open lights were sent to work.

9. "The mine foremen should carry flame safety lamps at all times while on duty and test every place for gas during their examination of the working places." The foremen were not carrying their safety lamps with them at the beginning of the inspection in November but began carrying them when reminded of the necessity for doing so in the interest of safety. They were carrying the lamps with them prior to the explosion.

Dust and Rock Dusting

1. "Preparations are being made to provide water for the arcwall cutting machine and the shearing machine; water should be provided at these machines as soon as is reasonably possible and used on the cutter bars while coal is being cut." These machines were not being used regularly prior to the explosion, but they had not been equipped with water tanks and the necessary fittings for applying water to the cutter bars. Evidence at the inquest indicated that much dust was made during the cutting of coal, which would imply that water was not being used effectively, or was not being used at all in some instances.

2. "Efforts should be made to secure an approved type of rock dust and the mine should be rock dusted. Haulageways and working sections should be rock dusted first. The rock dusting of coal mines is the most dependable method of combating the coal-dust explosion hazard." At the time of the inspection in November the mine was generally moist, and the coal-dust explosion hazard was seconadry to, although a factor in, the gas explosion hazard. The possibility of the mine becoming much dryer, and the coal-dust explosion hazard being increased, when the ventilation in the mine was improved, was explained to the management following the November inspection. The management had made inqury as to suitable rock-dusting equipment and sources of rock dust, but no action was taken. No rock dust had ever been applied in the mine.

Explosives and Blasting

"The management should consider using a permissible type of explosives in place of black pellet powder for blasting coal. Certain hazards exist when black powder is used, and, until replaced by a suitable type of permissible explosives, precautions should be taken to minimize the hazards, as follows:

1. "Instantaneous electric squibs, fired by permissible blasting units, should be used for firing all shots. Fuse, ignited by open lights or matches, should not be used." The practice of using fuse, ignited by open lights or matches, for firing shots was continued.

2. "Blasting should not be done until all men other than the shot-firers are out of the mine." The practice of firing shots near the end of the shift, while all men were still in the mine, was continued.

"Regardless of the type of explosives used, certain precautions should be taken in the interest of safety, as follows:

1. "Only sufficient explosives to last one day should be taken into the mine at one time. Too large a supply of explosives is being stored underground at this time." The supply of explosives stored underground was reduced.

2. "Explosives should be stored in substantial boxes, provided with locks and kept locked when not in use, in each working section. Explosives should be carried in canvas bags to the faces by the shot-firers, as needed. Explosives should not be hauled about the mine in a car hitched behind the drilling machine, as is now the practice." Boxes with locks were provided, also carrying bags, but the practice of hauling explosives about the mine in cars hitched behind the drilling machines was continued.

3. "Holes should be stemmed only with adobe or other incombustible material. Fine coal should not be used, as is now the practice." According to testimony at the inquest, some clay for stemming material was taken into the mine, but most holes were still being stemmed with "dummies" made of fine coal.

4. "Holes should not be charged while electrical equipment is in the place." The practice of charging each hole immediately after it was drilled was continued.

5. "Tests for gas should be made with a flame safety lamp before and after firing each shot, or round of shots." This was not being done.

Electrical Equipment and Wiring

1. "All bare feeder cables should be supported on insulators." No improvement was made over the existing conditions of supporting these cables on nails or track spikes driven into posts.

2. "These wires (bare feeder wires) should be installed on insulators and proper fittings should be provided for attaching the wires to the trolley-wire hangers." These feeder wires were installed in all rooms, supported on nails or track spikes driven into posts, and one end of each wire was twisted about a trolley hanger for a connection to the direct-current circuit. Many of these wires extended beyond the last open crosscut; this was called to the attention of the management, who agreed to correct same, and therefore it was not mentioned in the preliminary report. Insulators were installed to support some of the wires, but proper fittings were not provided for attaching the wires to the trolley circuit. The wires are still extended beyond the last open crosscut in many places.

3. "A number of sectionalizing switches should be installed on the direct-current feeder and trolley wires so that power can be cut off any idle portions of the mine. Also, cut-out switches should be installed on trolley wires at the entrance to each panel and on feeder wires at the entrance to each working place." The direct-current distributing system continued to be entirely interconnected. No switches were installed as recommended above. On the night before the explosion a small roof fall in a place off the inby end of the 5 southeast panel knocked the trolley wire down on the track, near a switch, and an 8-inch section was burned out of each of two 40-pound rails before the "short" was discovered.

4. "It is common practice in this mine to move cutting, drilling and loading equipment, and cable-reel locomotives by "nipping." This is an unsafe practice and should be discontinued." In discussing this immediately following the inspection, it was suggested to the management that immediate steps be taken to secure the necessary lengths of trailing cables so that this unsafe practice could be stopped. It was not evident, in the investigation made following the explosion, that anything had been done toward correcting this practice.

Haulage

1. "Considerable timber and wooden planking are used about the underground hoist and this creates a serious fire hazard. An effort should be made to reduce to a minimum the combustile material about this installation." Steel posts and concrete flooring were installed here to replace the wooden posts and flooring. The job was well done.

General

1. "It would appear that there is very little cooperation between employees and management in connection with the establishing and enforcing of safety practices. The management and employees should mutually assist and support all efforts toward greater safety in and about the mine." In November about 10 per cent of the employees were wearing safety caps and safety shoes; only 75 permissible electric cap lamps were available and in use; it was a common practice for employees to jump on and off moving man-trips. Recommendations were included in the preliminary report for the correction of these unsafe practices. In the discussion following the inspection, the management expressed doubt as to their ability to induce the employees to conform to these recommendations, and also the recommendation that smoking in the mine be stopped immediately. The inspectors offered to discuss these matters with the district president of the U. M. W. A., and did, the district president agreeing to discuss the items with the employees and urge compliance; what was done about this is not known. However, no change was made in the practices.

Following the completion of the inspection in November, the inspectors called on the State coal mine inspector and permitted him to read a pencil draft of the preliminary report. The report was discussed, and the State coal mine inspector was told of the efforts the mine officials and management were taking to minimize the hazards and of further efforts and improvements they agreed to take. It was suggested to the State coal mine inspector that he could cooperate by checking up soon and by seeing that the company continued to do as they had agreed. This the State coal mine inspector agreed to do. The State coal mine inspector made his next inspection of the mine on January 27, 1943, according to the report posted at the mine. It is apparent, in his report, that the unsafe practices referred to in the preliminary report of the Federal coal mine inspectors were not investigated.

The barometric pressure on the day of the explosion is not known. Gas was reported in 20 places, but the report of one fire boss, who was killed in the explosion, had not been recorded.

STORY OF THE EXPLOSION AND RECOVERY OPERATIONS

Saturday, February 27, 1943

The underground hoistman, Alex Hawthorne, in his testimony at the inquest, stated that the most terrific wind he had ever experienced came up the slope out of No. 3 bed. He apparently did nothing for a few moments, while endeavoring to figure out what had happened, then called the outside, saying—"There's something seriously wrong down here and I'm getting the hell out." He stated that was the last he remembered. This call was answered by one of the mechanics in the shop on the surface, the message was not understood, and the mechanic went to another telephone but could not get anyone underground to answer. The time was shortly after 9:30 a. m., Saturday, February 27.

The first actual knowledge on the surface that something was wrong underground came when two boys working near the mine portal either smelled noxious gases or saw smoke or dust issuing out of the haulageway portal and notified the mine office. This was very soon after Mr. Hawthorne's telephone call to the surface. A quick survey confirmed the fact that something was wrong; however, the fan was undamaged and continued forcing air into the mine. Word of the disaster was immediately broadcast by telephone, and shortly thereafter by radio from Billings.

According to Adolph Steinmasel, master mechanic, Matt Woodrow, Howard Freeman, Harold Wadsworth, and he entered the mine about 9:45 a. m. It was necessary to travel about 300 feet down the haulageway to a door outby the old 1 right panel before they could get into the intake airway. Doors were not provided at the fan house on the surface for entrance into the airway. Air exhausting naturally out an airshaft to the surface, just outby the underground hoist, tended to reduce the contamination of the air in the haulageway outby this point. However, the men got a headache in traveling to the door. They had one all-service gas mask, equipped with a partly used canister, and a flame safety lamp for protection. They entered the intake airway, and traveled down to the old 7 right panel to a door opening to the haulageway. Upon opening the door they found that the body of Ignac Marinchek, trackman, had been lying against it, as though he had managed to get to the door but became unconscious before he could open it. They carried the body into the intake airway, applied artificial respiration for about two hours, but could not revive him. In the meantime, Steinmasel went out onto the haulageway again and found Eli Houtenin, the trip rider who rode the trips, operated by the underground hoist, to and from the 1 west parting. Houtenin was about 25 feet from the door and unconscious. They carried him into the intake airway, applied artificial respiration, and after 10 minutes he showed signs of breathing. This man survived. When rescuing Houtenin, a light was observed up the entry; Steinmasel and Woodrow went up there as quickly as possible and found Willard Reid, a pumpman. He was unconscious. They carried him into the intake airway, applied artificial respiration, and he survived. Steinmasel and Woodrow then walked down the intake airway to a telephone near the centrifugal pump and called outside for more help. After some looking around, they returned to the point near 7 right where they met Loren Newman and Martin Rapp, foremen on the other two shifts, who had just arrived, and who had two all-service gas masks with them. Someone had taken the two rescued men to the outside.

Newman and Rapp entered the mine about 10:45 a. m., proceeded down the intake airway to the 7 right door, and met Steinmasel, Woodrow, Howard Freeman and Wadsworth. Newman and Rapp went out onto the haulageway and 400 feet outby the underground hoist, where they found Alex Hawthorne in an unconscious condition. They carried him into the intake airway, someone started applying artificial respiration, and Hawthorne survived. Newman and Rapp then went back out onto the haulageway and, 250 feet outby the underground hoist, they found Dewey Hardy, the trip rider on trips hoisted to the surface, and who apparently was dead. They got his body down to the 7 right door, into the intake airway, and artificial respiration was applied without success. Newman, Rapp, Steinmasel, and Woodrow then went inby along the intake airway and down the rock slope or shaft connecting the No. 2 bed airway with the No. 3 bed airway. They found the No. 1 booster fan blown to pieces and began work toward replacing the toppings along the 2 left airway. Only one stopping in No. 2 bed was damaged, but all stoppings, except a few near the outby end, along the main airways in No. 3 bed were destroyed. Hawthorne was assisted to the surface after he had recovered his strength. The two bodies also were removed from the mine.

In the meantime, the State coal mine inspector, Mr. Davies, arrived and entered the mine about 2:00 p. m. Other rescue workers from the vicinity of the mine, and from near Roundup, Montana, arrived through the afternoon and evening and immediately began assisting in the recovery work. During these early operations many of the rescue workers became ill from exposure to noxious gases but all recovered.

Messrs. J. A. Johnson and Emery C. Olsen, representatives of the Bureau of Mines, arrived from Butte and entered the mine shortly after arriving at 5:00 p. m. They traveled in the intake airway to the 1 west parting in No. 3 bed, the farthest point to which ventilation had been restored. Many of the workmen were ill as a result of exposure to noxious gases, when installing stoppings, and many of the stoppings were leaking air. In the meantime, the other Bureau representatives from Butte, Messrs. Courtney, Dolman, Hayball, and Evans, arrived at the mine about 7:35 p. m. Workmen were organized into crews, shifts allotted, and efforts pushed toward getting supplies into the mine and toward repairing and replacing the stoppings in No. 3 bed.

Four additional bodies were discovered, but not removed from the mine; one was along the 2 left haulageway, above the 1 west parting and three on or near the parting. All had apparently been killed instantly, three violently.

Sunday, February 28, 1943

Bureau representatives Arnold, Holland, and McCall arrived from Salt Lake City about 11:30 a. m. After consultation with other Bureau representatives and company officials, it was decided to rush the installation of an exhaust fan at the old Foster mine openings. These openings connected with the workings of No. 2 bed in the Smith mine, which in turn were connected by an inside rock slope, or shaft, with the upper workings in No. 3 bed. Work on the installation of this fan was begun immediately and was personally supervised by Marcel Cenis, superintendent of the Foster mine.

Two or more Bureau representatives were now available for each of the four 6-hour shifts worked daily during the recovery operations.

Requests were sent out for additional workers as the carrying of supplies from the door at 7 right down the intake airway to the workings in No. 3 bed was a slow and tiresome task. Work continued toward extending the ventilation down the intake airway of the main south slopes.

Monday, March 1, 1943

Work continued on the extending of the ventilation.

The emergency fan at the old Foster openings was placed in operation at 10:50 a. m. Tests of the atmosphere exhausted by the fan showed 0.30 per cent carbon monoxide and 0.50 per cent methane. The volume of air being exhausted could not be measured but at least 75 per cent of the air entering the mine was being exhausted by this fan.

In the meantime the ventilation had been carried down to the 5 west panel, the first panel in which workmen were thought to have been working.

Tuesday, March 2, 1943

The atmosphere exhausted by the emergency fan at the old Foster openings tested the same as on Monday. The main haulageway down to the underground hoist tested clear and man-trips were operated on it that night.

The 5 west panel was cleared and 6 bodies were found along the haulageway, outby room No. 4, more than 1,000 feet outby the place in which the men had been working. These men apparently died from exposure to noxious gases. The 5 west panel was affected very little by the explosion.

Wednesday, March 3, 1943

The working crew was called out of the mine at 5:00 p. m. because of a report that what appeared to be smoke was issuing from the old Foster openings. A check proved this to be false and work was continued. Tests showed 0.15 per cent carbon monoxide and 0.50 per cent methane in the atmosphere exhausted from the mine.

The main haulageway was cleared to the foot of the rock slope in No. 3 bed and the man-trips were operated to this point.

The 6 west panel was cleared. Five bodies were found in room No. 2. All were burned to some extent and the forces had been violent. One watch was found stopped at 9:30. The men had not moved.

The 7 west panel was cleared and one body was found along the haulageway between rooms Nos. 2 and 3. The clothes of this man were burned. He had been working on a stopping along the haulageway, 600 feet inby, where his cap and open light were found later.

Thursday, March 4, 1943

A check at the Foster emergency fan showed the carbon monoxide reduced to 0.10 per cent and the methane still at 0.50 per cent. The 2 left haulageway in No. 3 bed was cleared to the 1 west parting. Man-trips now operated to this point. Supplies also were transported to this point.

The 8 west panel was cleared. Five bodies were found in a slant between room No. 2 and room No. 3; all were burned and the men had been killed instantly.

Nine additional bodies were found along the haulageway inby room No. 2. Several of these men had been burned; all had moved from 40 to 400 feet from where they had been working.

In the meantime, men with oxygen-breathing apparatus had explored portions of the main south haulageway (return air) and recovered two bodies, one from near 4 west and one from near 5 west. Two bodies were found in the underground shop, opposite to 3 west, but the bodies were not recovered at this time.

The ventilation was carried forward rapidly now as the inby end of the main south entries was not far from 8 west. Three bodies were found at the face of the left hand slope of the three main south slopes. The clothing and bodies had been burned to some extent, and the men had apparently been killed instantly by violence. Starting up the east, or southeast as it is called, side of the mine, one body was found on the main south slope, near the 11 southeast panel.

Thirty-two bodies had been carried to the 1 west parting, awaiting the clearing of the 2 left haulageway so that the bodies could be hoisted to the surface. These bodies were removed from the mine that night.

Friday, March 5, 1943

The 9 southeast panel was cleared. Three bodies were found, two in room No. 5 and one in the haulageway near room No. 6. Two men apparently were killed instantly, one of whom was thrown some distance; his body was badly mutilated, and his clothes were entirely burned off or torn off by the forces and heat of the explosion. Clothes on the other two bodies were burned to some extent. The man outby room No. 6 had moved about 40 feet.

The 8 southeast panel was cleared sufficiently to locate twelve bodies along the haulageway between room No. 2 and room No. 3. A motorman and "nipper" had been struck violently by the forces of the explosion and thrown about 50 feet; the clothes on the two bodies were partly burned. The other men had walked out from the inby end of the panel, about 2,000 feet and apparently were overcome by the noxious gases.

The 7 southeast panel was cleared sufficiently to find eleven bodies along the haulageway. Six bodies were grouped near room 13, one was near room 15, four were near room 18, and one was near room 23. The man near room 23 was a tracklayer and usually stayed at work when the mine was forced to shut down because of a wreck or breakdown. It is assumed that these men may have thought the air disturbances, caused by the explosion, was the result of a wreck. The panel was affected very little by the explosion. The men moved up to 1,800 feet from where they had been working before being overcome by noxious gases.

The 6 southeast panel was idle at the time of the explosion.

The 5 southeast panel tested "clear" along the haulageway and an exploring party was able to go to the face without protective equipment. Seven bodies were found, which still left one man unaccounted for. The motorman and "nipper" were found along the haulageway, some distance apart, near the inby end, and the evidence indicated that they were taking a trip of empty cars

to the face when the force of the explosion struck them. The motorman was knocked off the motor and the "nipper" apparently stayed on the motor and fell off after the motor and cars had drifted downgrade toward the face. The other five men were found in a group in one of a pair of entries turned 45 degrees to the right and driven about 200 feet on a down grade. These men left notes indicating that they had lived until 11:05, no doubt of the morning of the explosion. The notes are included in the appendix.

Fifteen bodies had been carried to the 1 west parting and were removed from the mine that night.

Saturday, March 6, 1943

It was not certain who the missing man was and some thought he was a pumpman, so a systematic search was started of all places in which he might be found. Later in the day, word was received that the body of the pumpman had been identified, and that the body of Elmer Price, one of the mine foremen, had not been removd from the mine.

Twenty-three bodies had been carried to the 1 west parting and were removed from the mine that night.

Arrangements were made for one searching party only, including eight men equipped with rescue apparatus, to report at 1:00 p. m. the following day.

Sunday, March 7, 1943

The searching party entered the mine about 1:00 p. m. and, beginning at the 5 southeast panel, they examined each room carefully, four-man rescue crews alternating in examining the rooms. About 3:15 p. m. the body of Elmer Price was found in room No. 12. He evidently had started up this room when the explosion occurred and apparently fell against the rib of the place upon being struck. It would appear that he was killed instantly.

The last two bodies, including one body from 7 southeast panel, were removed from the mine about 6:00 p. m.

INVESTIGATION OF CAUSE OF EXPLOSION

After the recovery of the bodies, the miners were reluctant to return to work until all funeral services were held. Very little work toward restoring the ventilation was accomplishd during the period March 8 to 13. A substantial crew of men began work Sunday, March 14 and the clearing of all places necessary for the investigation was completed Saturday, March 20.

M. C. McCall, of the Bureau, assisted up to this point and was then called to Salt Lake City. He contributed to the reasoning and findings which follow.

The investigation to determine the cause of the explosion began Monday morning, March 22, and continued through March 29. The personnel of the joint investigating party is included near the beginning of this report.

Forces

Forces of the explosion are indicated on the map appended to this report. A study of the evidences of forces and propagation of the explosion indicates that the explosion occurred in the 9 southeast panel. The explosion very evidently propagated outward from near room No. 5, and at the junction with the main south slopes traveled outby and inby.

Traveling up the return, or left side entry, of the main south slopes, the forces entered both entries of the 8 southeast panel, destroying and moving a booster fan 235 feet in the back entry, and derailing and causing some damage to a locomotive a short distance inby on the haulageway. The major forces continued up the return airway, and also the main haulageway.

It is evident that the violence of the forces traveling down the return airway, and also the middle entry, or haulageway, moved a filled sand box in the return airway, just outby the 10 southeast haulageway. The sand box, 2- by 2½- by 6 feet in size, was originally parallel with the track, and across the airway, and one end was moved 2½ feet toward the track. The explosion very evidently propagated on down the return airway, increasing in intensity, and struck the drilling crew at the face of the entry. These men were struck hard and their clothing and bodies were badly burned. Black pellet powder was evidently being transported in the car behind the drilling machine, and it was burned. The linings and doors of the powder-storage boxes on the utility car behind the drill were blown outby on the entry, no doubt by the rebound of the forces.

The forces also traveled down the haulageway, or middle entry, from 9 southeast. Most positive evidence was a filled sand box on the entry and near the entrance to the 11 southeast panel. The end of this sand box faced up the entry but the sand box was definitely moved 2 feet toward the face. It was evident that the major force went down the haulageway and that a later force came back up from the lower end, no doubt the result of propagation across into the west side panels.

All stoppings along the main airways were destroyed, but many stoppings in a number of the panels were not affected. The explosion did not propagate to the interior of the long panels, no doubt because of the presence of some moisture and also the cooling effect of the large number of rooms into which the heated gases could expand.

The forces of the explosion were violent along the main entries in the upper part of the workings in No. 3 bed, but not nearly so violent as in the 9 southeast panel, and from this panel inby to the face of the main south slopes, and outby to the 8 southeast panel. The forces in the upper part of the workings in No. 3 bed extended to the outby end of the intake airway, but only 1,300 feet up the haulageway.

The limits of the extent of the forces of the explosion are shown on the map in the appendix.

Evidence of Heat or Flame

Evidence of heat and flame is very apparent along the main entries in No. 3 bed from the faces outby to points on the haulageway and intake airway 1,300 feet outby the 1 west parting. The workings in some panels were nearly all exposed to heat and flame, but considerable portions of other panels were not affected. The extent of heat and flame is shown on the map in the appendix.

Property Damage

Property damage included the destruction of 3 booster fans, some damage to locomotives, the destruction of switch panels at rotary-converter stations,

the deranging of trolley and power wires, and the destruction of all stoppings (wooden) and doors along the main entries and many inside the panels. Some timbers were blown out resulting in several caves of roof material.

Summary of Evidence as to Cause, Origin, and Propagation

Unlike most explosions, the difficulty in this investigation was to determine which one of a number of possible source of gas ignition started the explosion. Facts related to the explosion are as follows:

1. Efforts toward keeping line brattices up to the working faces were inadequate. Line brattices generally were much too far from the faces. Gas was being found in entirely too many places daily.

2. Accumulations of gas were permitted to stay in place for weeks at a time.

3. Haulagemen generally left doors across haulageways open and brattice curtains at room entrances up when gathering coal. Doors were erected singly.

4. It is questionable whether the total volume of air reaching the working section of the mine had been increased to where the gas content of the return air generally on the east side of the mine had been materially reduced.

5. Very little precaution was taken as to where men with open lights were sent to work. All employees were not equipped with permissible electric cap lamps.

6. Smoking was permitted in the mine.

7. Evidence at the inquest indicates that the application of water on cutter bars, while coal was being undercut, was ineffective and inadequate, and that water was not being used on the cutter bars of certain machines.

8. The mine was not rock dusted.

9. Shots were being fired by fuse which was ignited by matches or open lights.

10. Electrical equipment was moved in the face regions by "nipping."

11. Feeder wires extended beyond the last open crosscuts in many places.

12. The entire direct-current system was interconnected and was energized whenever the power was on. Section and cut-out switches were not provided.

Probable Cause of the Explosion

It is the belief of the Bureau investigators that the explosion originated in room No. 5 off the 9 southeast panel. This room is 260 feet deep and is connected with No. 4 room by a slant about 100 feet from the entry.

According to various information received, the line brattice was extended to within 70 to 100 feet of the face. The place was drilled and shot about 10:30 p. m. the night before the explosion. Gas was recorded as found in the place February 20, 21, 22, 24 and 25. The man who acted as fire boss on the night shift (up to midnight) on February 26 stated to the investigators that he found gas in the place that night, before the face was drilled and blasted.

For some reason, a record was not made of gas being found in the place on February 26. On the morning of the explosion, the fireboss who was killed examined this panel, and there is no record of his findings.

At the time of the explosion, two men were working in the place. A timber- and brattice-man, wearing a permissible electric cap lamp, had apparently been working, or standing, in the room near the slant. His body was found 30 feet outby the slant, and his electric cap lamp and belt were near the slant. He had been hit hard and his clothing was burned to some extent. A trackman, wearing an open light, apparently was laying a switch about 70 feet outby the face. His naked body, badly mutilated and burned, was found on top of the coal pile at the face, his track hammer in under his body. A spike bucket with some bolts and a drill bit in it, a shovel handle and other debris were found on the coal pile. The man's badly burned clothing was found near where the switch was to be laid and his battered carbide lamp was found about 60 feet from the face. On a later visit into the mine fungus growths were observed on the roof a short distance inby where this man had been working on a switch. These fungus growths were similar to those on the floor where bodies had lain and no other such fungus was evident on the roof, any place in the mine. It would appear this man was thrown to the roof almost directly above where he had been working and then into the face more than 60 feet away. He apparently had his track hammer in his hand and clung to it.

Also, at the time of the explosion, David Murray, one of the foremen, was at the face of room No. 6 apparently testing for gas. This room is only about 25 feet deep. Murray's hard hat and safety lamp were found at the face and his body was found at the switch on the entry. He had traveled 40 feet after the explosion.

Evidences of intense heat and forces are present in room No. 5 and inby to the face of the entry, about 280 feet distant. The major forces appear to originate near room No. 5.

It is thought that the initial ignition occurred when the accumulation of gas in the place came in contact with the open light of the trackman. An unusual accumulation would have to be present to make this possible, and also to make possible the intensity of the explosion resulting in these places. The initial ignition probably resulted in an explosion that propagated instantly to the face of the entry and then back into the place with increased intensity. The two stoppings along the entry opposite to and inby room No. 5 were blown toward the back entry and the two stoppings outby there were blown up toward the haulageway.

There were no other men in this panel at the time of the explosion. Other possibilities of ignition, such as smoking, could be considered, but there is no evidence to substantiate it. According to statements of local men assisting in the recovery work, the 9 southeast panel was very dry prior to the explosion. Explosive gas was present in room No. 5 during the investigation.

There was some discussion as to whether it was not likely that the mine foreman would have gone into room No. 5 first, because men were working there. This would be logical at most mines, but there is nothing in the evidence pertaining to the operation of this mine that would indicate such a practice

was to be expected. The evidence of gas having burned in and about room No. 5 are such that had the mine foreman gone in there first he would probably have found conditions that would have necessitated removing the men in the interest of safety.

In considering other possible sources of ignition it was impossible to reconstruct a path of propagation that would fit in with the definite path of propagation as defined in the mine by the evidences of intense heat and by the violence and direction of the forces.

Source of the Explosion as Arrived at by Edward Davies,

State Coal Mine Inspector

As a result of the investigation, Mr. Davies is of the opinion that the explosion originated near the face of the 8 west entry, and that the initial ignition was caused by an open light worn by a trackman.

The face of the 8 west entry is about 140 feet ahead of the last open crosscut. Room No. 6 was turned a short distance inby the crosscut and was driven about 70 feet. A "slant" had been started 30 feet outby the face of the entry and had been driven about 15 feet. A line brattice had been constructed across the entry, outby the open crosscut, and extended just past room No. 6, which room is about 110 feet from the face of the entry. On this morning and several days prior to the explosion, these places had been reported clear by the fire boss.

On the morning of the explosion, the machine crew had cut the "slant," the face of the entry, and had sumped the cutter bar in the upper left-side corner of room No. 6 when the explosion occurred. These men were wearing permissible electric cap lamps. Their bodies were found on the haulageway a short distance outby room No. 6. The trackman had worn an open light. His body was found on the haulageway, just inby the open slant.

Mr. Davies analyzed the situation as follows: "The trackman's tools and lunch bucket were in room No. 1. He probably had laid the switch at the inby slant the day before and had returned there to get some tool or material needed in room No. 1. The "slant" and near-by face had just been cut and no doubt considerable gas was liberated and had accumulated there. The trackman, upon reaching the slant, had ignited the gas with his open light. There are evidences and flame and of gas having burned in all the inside places in 8 west. A cave found in the return airway of the 8 west panel, just outby the second slant from the face, may have occurred that morning, and it would definitely have retarded the flow of the air current. Small quantities of explosive gas were found at high points in all three places during the investigation, nearly a month after the explosion, the door in the slant leading to the 8 west entry, from the main south haulageway, was blown outward, and the two stoppings in slants along the main intake airway, just outby 8 west, were blown toward the main haulageway." All of the above facts are substantiated by evidence in the panel. The reasoning is good, but the only difficulty in accepting the solution is that of reconciling this solution with the definite path of propagation as described in the discussion of the 9 southeast panel.

In analyzing conditions in the 8 west panel, Bureau representatives considered seriously the possibility of the explosion originating in the "slant" between room No. 2 and room No. 3. A body of explosive gas had stood in the dead-end slant turned to the right off room No. 2 for about two months, and it was considered possible that increased ventilation up room No. 2, caused by the loading out of more than half of the last cut of coal in the "slant," which gradually enlarged the opening into room No. 3, had drawn a streamer of this gas over open lights worn by some members of the loading crew, the bodies of whom were found in the slant. This appeared to be a very likely source of the initial ignition.

In trying to tie this possible origin into the path of propagation defined by the evidences of violent forces, it was diffcult to reason how the explosion could propagate from 8 west and react as follows:

1. Develop force enough to move a sand box down the main haulageway, or slope. This sand box is about 400 feet down the slope from the "slant" leading to 8 west.

2. Propagate outby and then reverse and propagate inby with sufficient violence to move one end of a sand box, near the 10 southeast panel, 2½ feet toward the face of the slopes. The 10 southeast is opposite to, and about 400 feet outby the 8 west panel.

3. Get outby the door across the main haulageway, just inby the 9 southeast panel, and blow the door inby toward the face of the slopes with the force evident in the condition of the door posts and hinges. This door is about 800 feet outby the entrance to 8 west.

4. Enter the slant to the 9 southeast panel against the direction in which the door opened and leave the positive evidence that the door was blown outward with great force. The door post, which must be very solid, was moved outward at the roof.

In analyzing the evidence that the door at the entrance to the 8 west panel was blown outward, it was reasoned that the explosion, in propagating from 9 southeast down the return airway and the main haulageway expanded through some of the stoppings to the intake airway. As the door in question swung in toward 8 west, the forces opened the door, but without sufficient violence to destroy it, and entered the panel. The explosion propagated through all workings in the panel and the force of the expanded gases moved out of the panel closed the door and blew it outward and up the slope, or main haulageway. There are evidences of forces in both directions in the 8 west panel.

Lessons to be Learned from This Explosion

It is evident from the foregoing discussion that the most elementary safe mining practices were being disregarded in the operation of this mine. A repetition of the facts set forth, and the lessons self-evident, in the discussion of "Mine Conditions Prior to the Disaster" would be superfluous.

Coroner's Inquest

The Coroner's inquest into the explosion was held in Red Lodge, Montana on April 12, 13, and 14, 1943. The verdict of the jury, and the names of the victims of the explosion are included in the appendix.

Testimony in general at the inquest, although contrary in several instances, was to the effect that conditions in the mine had been improved since the inspection made by the Federal inspectors in Novmber, 1942, and that conditions prior to the explosion were normal. Facts disclosed in this report do not substantiate this testimony, fully.

RECOMMENDATIONS

It is believed that compliance with recommendations included in the preliminary report covering the inspection of this mine in November, 1942, will provide reasonable security against a repetition of such as disaster in this or other mines.

These recommendations could be expanded and amplified in the interest of greater safety, and have been in the final report covering the November inspection of this mine, but this is purposely avoided here to stress the fact that reasonable protection against the gas-explosion and dust-explosion hazards can be attained by compliance with the recommendations included in the preliimnary report.

ACKNOWLEDGMENT

Opportunity is taken here to acknowledge the outstanding service rendered by the local women and the representatives of the American Red Cross during the recovery operations at the mine.

The Montana Highway Patrol is to be commended for placing patrolmen and automobiles at the service of the rescue workers and transporting them to and from Red Lodge during the very severe winter weather experienced the week of the recovery operations.

The Anaconda Copper Mining Company of Butte, and the Defense Chrome Account Mines of Benbow and Mouat, Montana are to be commended for sending rescue crews and an abundance of rescue equipment.

The many rescue workers, including volunteers from other occupations, are to be commended for their untiring efforts and willingness to do any task assigned them.

The representatives of the Bureau of Mines also wish to acknowledge the courtesies extended and the full cooperation given to them by the officials of the Montana Coal & Iron Company. Every request for additional assistance, materials, or equipment was immediately complied with.

Respectfully submitted,

G. O. ARNOLD, Senior Coal Mine Inspector,
M. C. McCALL, Mining Engineer,
F. J. BAILEY, Senior Mining Engineer.

APPROVED:

E. H. DENNY, Chief, Coal Mine Inspection Division.
D. HARRINGTON, Chief, Health and Safety Service.

APPENDIX

Verdict of Jury

STATE OF MONTANA,)
) ss.
COUNTY OF CARBON,)

AN INQUISITION taken at Red Lodge in the County of Carbon, on the 12th, 13th and 14th of April, A. D. 1943, before Edward Olcott, Jr., Coroner of the said County of Carbon, upon view of the bodies named on the attached list, lying there dead, by the oaths of the Jurors whose names are hereto subscribed, who, being sworn to inquire, on the behalf of the State of Montana when, how, and by what means, the said persons came to their deaths, upon their oaths do say:

That on February 27th, 1943, at the coal mine of the Montana Coal & Iron Company located at Washoe, Montana, met their deaths due to concussion and to gas poisoning caused by gas and dust explosion.

As a part of this verdict, we, the jury, impanelled on the coroner's jury recommend that our present mining laws be amended and new laws be enacted as follows:

1. That the State and Federal Coal Mine inspectors be given power to close any coal mine or part thereof where said inspector find any hazard that he considers dangerous to the health and safety of employees.

2. That blasting of coal be not permitted when men are working in the mine, unless permissible powder is used.

3. That every underground employee be furnished with self-rescue equipment.

4. That helmets and gas masks in workable condition, in sufficient quantities, be kept at the mine to supply rescue crews in case of emergency.

5. That rescue crews be trained for rescue work and be supplied with all necssary quipment.

6. That all coal mines be rock-dusted.

7. That ventilation systems be improved immediately when requested by mine inspectors, and that booster fans be discontinued.

8. That a competent employee, selected by employees, must also accompany the state mine inspector on his official mine inspection.

9. That the intake air system should be on the man-way or haulageway when the mines have regular man trips.

10. That each local union of the mine involved be furnished a copy of each mine inspector's report.

IN TESTIMONY WHEREOF, The said Coroner ond Jurors of this inquest have hereunto set their hands, the day and year, to-wit, this 14th day of April, A. D., 1943.

C. F. Chamberlain
Edward Bloom
Eli Pekich
J. J. Gerondale
Celeste Roat
John Mikesell
John Mance
Anton Columbus
William C. Godina

JURORS.

ATTEST:

EDWARD OLCOTT, JR.,
Coroner of Carbon County, Montana.

List of Men Killed in Mine Explosion at Smith Mine of Montana Coal & Iron Company, February 27, 1943

NAME	AGE	OCCUPATION
James Allison	51	Track-layer
Emil Anderson	40	Greaser & Repairer
Sam Alexander	57	Bratticeman
William C. Appleton, Sr.	50	Goodman Helper
Sam Barovich	56	Faceman
William F. Barry	26	Shaft Sinker
William Beeney	53	Machineman
Jules Besinque	51	Goodman Operator
John Bone	59	Laborer
Leland J. Cline	26	Nipper
David J. Davis	42	Motorman
William DeBourg, Sr.	55	Machine Repairer
August Deruelle	62	Tracklayer
Patric Doran	38	Nipper
Marcel Fages	40	Motorman
Joe Ferro	51	Tracklayer
John Germanetti	60	Tracklayer
Pete Giovetti	38	Motorman
Matt Hallila	57	Timberman
Art Halpin	42	Motorman
Admiral Dewey Hardy	42	Rope Rider
James Hawthorne	30	Motorman
John Hodnik	31	Tracklayer
Walter Joki	30	Tracklayer
Wayne Jones	31	Nipper
Andrew G. Jordan	21	Nipper
Mike Korinko	33	Shooter & Driller

NAME	AGE	OCCUPATION
John Krop, Sr.	59	Tracklayer
Louis Kuhar	56	Faceman
Edward O. Kumpula	35	Timberman
Edward Laird	55	Timberman
Edward J. Laird	49	Joy Helper
Element Scarr Lodge	51	Goodman Operator
Abe McDonald	59	Joy Helper
Joe McDonald	32	Nipper
Robert McDonald	42	Machineman
James McNeish	65	Faceman
John Maden	53	Motorman
Ignac Marinchek	57	Tracklayer
Frank Mourich	42	Head Electrician
Jack Philip Mourich	36	Machine Repairer
Richard Mallin	68	Timberman
John Meklejohn	51	Fire Boss
Herman Mejean	19	Trapper
Joe Meyer, Jr.	39	Goodman Helper
Wilbur Muller	22	Nipper
David Murray	56	Foreman
Earl Mus	51	Tracklayer
William A. Nelson	51	Machineman
William Noble	68	Shooter
Frank Pajnich	53	Timberman
William Mathew Pelo	46	Laborer
Elmer Price	53	Foreman
William Pryde	32	Motorman
Eino Rahkola	27	Timber Helper
Ferdinand Rasborchek	61	Faceman
Martin Ratkovich	46	Goodman Helper
David B. Reid	33	Joy Operator
Lawrence Reid	41	Machineman
George J. Saarela	33	Laborer
William Shepard	69	Safety Man
William Slaby	38	Tracklayer
David Sommerville	60	Faceman
John Sommerville	34	Goodman Operator
Frank Starkovich	64	Laborer
John Sudar	28	Joy Operator
Frank Sumisek	65	Tracklayer
George Thomson, Sr.	63	Laborer
Adam Wakenshaw	72	Tracklayer
Robert Lee Wakenshaw	39	Shooter
Robert Whitehead	47	Motorman
Clarence Carlye Williams	42	Motorman
Lloyd Williams	45	Pumpman
Vic Zaputil	50	Tracklayer

STATEMENT OF EMPLOYEES, AS MADE TO FRED J. BAILEY

No. 1

Adolph Steinmasel—Machinist

"Matt Woodrow, Howard Freeman, Harold Wadsworth, and I were the first persons going underground after the explosion. We left the surface about 9:45 a. m., had one smoke mask (seal was broken on it). When we entered the slope portal the air was bad and I got a headache from it. We traveled on the slope haulageway about 300 feet to 1st right where we entered the airway. Matt Woodrow had a flame safety lamp and was leading the party. We entered the haulageway at 7 right door. Matt Woodrow opened the door and we found Ignac Marinchek, trackman's body lying against the door. We carried his body back to the airway. Freeman and Wadsworth applied artificial respiration about 2 hours without reviving him. I walked out on the haulageway and saw Eli Houtenin, No. 3 rope rider, about 25 feet from the door. He was unconscious. Matt Woodrow, Howard Freeman, and I carried him back into the airway and started artificial respiration; after about 10 minutes he showed signs of breathing. I did not hear him speak. At the time I found Houtenin I looked up the entry and saw a light. Later Matt Woodrow and I went to the light and found Willard Reid, pumpman. We carried him back into the airway. He was unconscious. Artificial respiration was applied, but he never spoke. We left two men to apply artificial respiration and Matt Woodrow and I walked down the airway to a telephone at the centrifugal pump and called outside for help. We walked on down the airway to a point about 100 feet above the first booster fan. We then walked back up the airway, then went into the No. 2 seam, intending to go down to the airshaft that connects No. 2 and No. 3 coal seam, but we could not find the airshaft. We returned to 7 right door. Newman and Rapp were there. They had two smoke masks. Someone had taken the injured men, (Houtenin and Reid) to the outside. Woodrow, Newman, Rapp, and I went down the airshaft to the No. 3 seam to a point about 100 feet above the booster fan. We stopped there a short time then went on down to the booster fan and found it had been blown to pieces. We repaired two stoppings below the booster. I left then and went to the outside.

"Sometime during the early afternoon I went underground. At 7 right door I met Matt Woodrow. Two men were assisting him to walk. I was busy getting material down during the afternoon.

No. 2

Loren Newman—Foreman, Night Shift (11:50 p. m. to 7:00 a. m.)

"About 10:30 a. m. February 27, 1943, I was notified by telephone to come to the mine. About 10:45 a. m. Martin Rapp and I took two gas masks and went underground, traveling on the slope haulageway to 1st right, and then into the airway, then to 7 right door. The trackman (Marinchek), rope rider (Houtenin) and pumper (Reid) had been carried into the airway.

Martin Rapp and I went out on the haulageway, then up same to the No. 3 hoist. We found Hawthorne, (hoistman). He was unconscious. (We were wearing gas masks at the time). We carried him down to the 7 right then into the airway. Someone started artificial respiration. We then went back out on the haulageway and up outby the hoist and found Dewey Hardy about 250 feet above

No. 3 hoist. He was **dead.** He was lying on his back alongside the rear car of a loaded trip (13 cars) and his dinner bucket was between his knees. We put his body on a locomotive which was nearby and let the locomotive coast down to near 7 right door, where Matt Woodrow and Roy Wadsworth came out on the haulageway and helped us carry Dewey Hardy's body back into the airway. Artificial respiration was started on him. Matt Woodrow, Martin Rapp, Steinmasel, and I went on down toward No. 3 seam repairing stoppings."

No. 3

Johnny Reid—Mechanical Loader Operator

"I was dressed and ready to start to Billings, Montana. About 10:50 a. m. 2-27-43 I was notified of the explosion. I went immediately to the Smith mine, arriving there about 10:55 a. m. Joe Neglich went underground with me. We traveled the main slope from the portal to the No. 3 hoist. We found Dewey Hardy first, his chin was quivering. I walked down to about 20 feet above No. 3 hoist. I fell on my knees, then got up, and returned to the surface and secured more men and went underground again, down the airway to 6 right door, then out on the haulageway, then down past No. 3 hoist, to the 7 right door. We then walked back up the haulageway passing No. 3 hoist and entered the airway at 6 right door. We then helped carry Willard Reid about 1,000 feet when another crew took him and I returned to 7 right."

Notes left by men found near the inby end of 5 southeast panel. The notes were written with chalk on scraps of boards.

Front and Back of one Board:

Front

"We 5 men pass 11 oclock
dear Agnus & children
I'm sorry we had to go this
God bless you all Emile with lots
kiss"

Back

"Frank Pinich
John Sudar
and Joki
We tried our best but could not
get out."

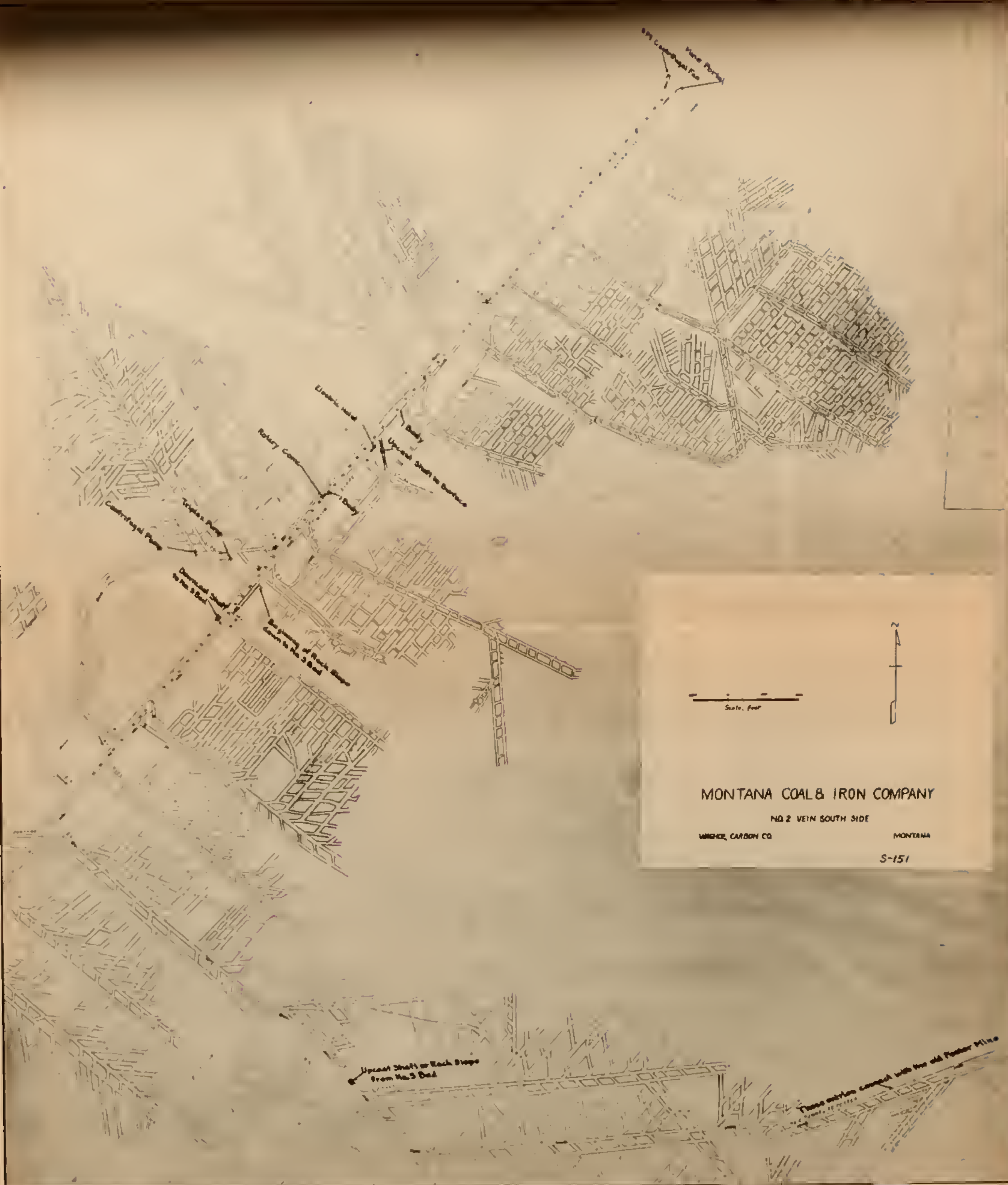
Second Board:

"Walter & Johnny Good-bye
Wife & daughter to
We died an easy death
love from us both
Be good."

Matt Woodrow

Matt Woodrow passed away April 7, 1943, at the age of 61, after a short illness. Mr. Woodrow had retired several years ago but returned to work when the shortage of men became acute. He was employed on the surface prior to the


NO. 3 BED
SMITH MINE
MONTANA COAL & IRON CO.
No. 3 Bed is 90 feet below No. 2 Bed
LEGEND
Double-Board Stoppings
Drattice Curtains
Doors
Mine Cars
Locomotives
Major Forces
Minor Forces
Limit of Forces
Limit of Heat or Flame
Direction of Air Flow
Shaft or Rock Slope up to No. 2 Bed
Air Samples 82614-18 82038-39
Air Samples 82040-41
12 in. Concrete Seals blown inward
Dust Samples B 30772-78
Limit of Forces
Pump
3 SE
No. 3 Booster Fan, blown away
Five 60-lb rails blown edgy into center of track
2 Bodies
1 W Parting
R.C. Stks
2 Bodies Steep
7 SE
Shaft or Rock Slope driven up to No. 2 bed workings. Not quite broken through
8 Bodies
Loading Mach.
Messages on boards found at this point
11 Bodies
Loading Mach.
1 Body
Motorman
12 Bodies
R.C. Stks
8 SE
Dust Samples B 30779-81
Pump
Locomotive
Hopper
Pump
No. 2 Booster Fan
9 SE
9 Bodies
Loading Machine
The No. 2 Booster Fan in 8 SE was blown 295 feet inby
Possible source of the explosion
Sand box, opened 6 ft. inby
Coal
1 Body
Motor
Loading Machine
Was moved from here
14 Bodies
Mining Machine
Coal
Sand box, opened 2 ft. inby
1 Body
11 SE
Portable Drill & Power Car
S-151


MONTANA COAL & IRON COMPANY
NO. 2 VEIN SOUTH SIDE
WASHOE, CARBON CO.
MONTANA
S-151
Scale, feet
Electric Hoist
Rotary Conv.
Upcast Shaft to Surface
Triplex Pump
Centrifugal Pump
Downcast Shaft to No. 3 Bed
Beginning of Rock Slope down to No. 3 Bed
Upcast Shaft or Rock Slope from No. 3 Bed
These entries connect with the old Foster Mine
Mine Portal

explosion, and was one of the first group to enter the mine after the explosion. He was overcome by noxious gases the first day but recovered quickly and assisted in the recovery operations until the last body was found. He had assisted for a number of days in the restoration of the ventilation in the mine when he became seriously ill. His illness may or may not have been a result of exposure to noxious gases during the recovery operations. His passing is regretted by his many friends in the Bureau, and has added greatly to the grief of the stricken Red Lodge, Washoe, and Bear Creek communities.

Question

Why was this mine not inspected prior to November 1942?

This question was asked the Federal Coal mine inspectors and was answered by Arnold at the inquest about as follows:

"Mr. Frank J. Stortz, coal mine inspector, was assigned to the Seattle office of the Bureau of Mines, and reported for duty February 11, 1942. His duties were to inspect coal mines in Washington and Montana. He completed the inspection of one mine in Washington and was working on the inspection report when, being an officer in the Army Reserve Corps, he was called to the service. He resigned February 23, 1942.

"Another man was not available for assignment to Washington and Montana until August 17, 1942, when W. H. Walsh, coal mine inspector, reported for duty in Seattle.

"Mr. Walsh's first duties were to complete the report started by Mr. Stortz, after which he inspected another mine in Washington.

"In the meantime, Mr. Denny, Chief of the Coal Mine Inspection Division, became concerned over the fact that no coal mines had been inspected in Montana, and about November 1 suggested to the Salt Lake office that inspectors be sent to Montana to inspect a couple mines. Plans were made to do this when a letter arrived stating that it would be satisfactory for Mr. M. R. Evans, mining engineer, Mineral Production Security Division, who was stationed in Butte, to make inspections of coal mines. He (Arnold) explained that the Division in which Mr. Evans worked had been created by a separate act of Congress and that special permission had to be obtained, because of the different provisions for funds, before men in the Mineral Production Security Division could be permitted to inspect coal mines.

"As Mr. Evans had not been given the course of instruction provided for men in the Coal Mine Inspection Division, he was sent to accompany Mr. Evans during the inspection of two mines. As this was Mr. Evans' first inspection following Bureau procedure, he took charge in making the inspection of the Smith mine, and Evans took charge in making the inspection of the Foster mine of the same company."

CORONER'S EXHIBIT NO. 3

STATE OF MONTANA

Industrial Accident Board

J. Burke Clements, Chairman

Albert H. Kruse
John J. Holmes
W. W. Casper, Secretary of Board

Nell O'Connell, Assistant Secretary
H. O. Mead, Accountant

Helena, Montana, January 27th, 1943

AIR READINGS TAKEN AT SMITH MINE

5th West—Back entry last x-cut 4,000 cu. ft.—10 men
Room X-cut 8 and 9—3,200 cu. ft.
Room X-cut 7 and 8—2,600 cu. ft.
Room X-cut 6 and 7—No reading
Room 5 end of canvas—1,200 cu. ft.
9th South Room No. 1 end of canvas—No reading
Room No. 2 end of canvas—No reading
Room No. 3 end of canvas—1,800 cu. ft.
Room No. 4 end of canvas—2,700 cu. ft.
Room No. 5 clear of gas—No reading
9th South Entry end of canvas—15,600 cu. ft.
9th South Entry Last X-cut—10,000 cu. ft.
10th South East Room No. 1 end of canvas—6,200 cu. ft.
Room No. 1 gas at face deadlined
Gas at face of Room No. 2 to be removed
End of Canvas Reading Room No. 3—5,800 cu. ft.
End of Canvas in Entry—1,800 cu. ft.—10 men
11th South East Entry end of canvas—7,500 cu. ft.
1st South Back Entry X-cut—10,600 cu. ft.
Main Entry X-cut—14,500 cu. ft.
9th South, Back Entry X-cut—16,00 cu. ft.
Main Entry, end of Canvas—No reading
8th West Back Entry X-cut—10,500 cu. ft.
8th West Main Entry end of canvas—3,500 cu. ft.
Room No. 2 end of canvas 500 cu. ft.—10 men
Room No. 2 deadlined on account of gas
7th West Back Entry X-cut—8,500 cu. ft.
7th West Back Entry—No reading—10 men
Room No. 6 deadlined—End of canvas—No reading
Room No. 5—No reading—Room No. 1 deadlined
Room No. 1 end of canvas—1,500 cu. ft.

Room No. 2 X-cut—2,500 cu. ft.—10 men
8th South, Room No. 11 end of canvas—5,600 cu. ft.
8th South, Room No. 12, end of canvas—6,200 cu. ft.
8th South, Room No. 13 end of canvas—6,600 cu. ft.
8th South, Room No. 14 end of canvas—6,800 cu. ft.
8th South, Room No. 15 end of canvas—2,300 cu. ft.
8th South, Room No. 16 end of canvas—No reading
8th South, Room No. 17 end of canvas—2,000 cu. ft.
8th South Back Entry X-cut—18,000 cu. ft.
8th South Main End of Canvas—8,600 cu. ft.
7th South East Main—End of Canvas—6,400 cu. ft.
Room No. 22—End of canvas—No reading
Room No. 22 and 21 X-cut 7,200 cu. ft.
Room No. 21 end of canvas—1,500 cu. ft.
Room No. 20 end of canvas—3,500 cu. ft.
Room No. 18 and 19 X-cut—2,400 cu. ft.
Rooms 15-16-17-18 No readings—10 men
2d South Back Entry end of canvas 15,000 cu. ft.
2d South Main Entry end of canvas—5,800 cu. ft.
5th South East Back end of canvas—3,600 cu. ft.
5th South Main end of canvas—3,000 cu. ft.
Room No. 15—2,500 cu. ft. Room No. 14 deadlined. Room 13—No reading
Required quantity of air to be conducted to all working faces.

Signed, ED DAVIES,
Coal Mine Inspector

Billings, Montana, May 3rd, 1943

To the Industrial Accident Board,
Helena, Montana.

Gentlemen:—

We, the undersigned, herewith submit our report of the explosion that occurred at the Smith Mine, Washoe, Carbon County, on Saturday, February 27th, 1943.

The explosion occurred at about 9:35 a. m. There were 77 men in the mine at the time, and of these only 3 were rescued. The engineer at the hoist in the No. 2 vein (Hawthorne) telephoned to the surface to the effect that something very serious had taken place and that he was getting out.

Outside employees immediately entered the mine, traveling through the main air course to a point opposite the hoist, and then through a connecting cross cut to the main slope parting. At various relatively short distances from the hoist they found the engineer and 4 others who had been overcome by the afterdamp. Three of these responded to resuscitation treatment but two could not be revived. The 5 men were taken out of the mine before noon.

The news of the disaster quickly spread and the miners of the community hastened to the mine in order to assist in possible rescue work. But of the 72 men who were in the No. 3 vein when the explosion occurred not one escaped.

Within one hour after the explosion occurred the Red Cross organization established a canteen in the machine shop a short distance from the entrance to the mine. The quality and the quantity of the food and the services rendered by the women in charge of the canteen won the sincere appreciation of all the men who took part in the recovery operations.

The State Highway Patrol attended to the transportation needs of all. The service which they rendered at a time when it was most needed, their courtesy, discipline and efficiency left nothing to be desired. It may be said that the county, state and federal agencies were united in an effort to rescue possible survivors of the disaster in the No. 3 vein. We regret to report, as the record reveals, that their labor and hopes were all in vain.

Miners and mine officials hastened to the scene as quickly as possible from Klein and Roundup and Stockett, and the Moat and Benbow mines in nearby Stillwater county to offer their services. These men demonstrated once again the traditional disregard for danger that miners always display as long as any hope remains and those who have been trapped in a mine by an explosion may be rescued.

Mine rescue squads from Butte and the Moat and Benbow mines of the A. C. M. lost no time in arriving at the mine. These **Helmet** men possessed a high degree of courage. They were ably led, and they brought to their work the skill and experience that they had acquired through training in mine rescue and recovery operations. They remained at their task, which combined danger with horror, until it was completed. They cannot be too highly praised.

The U. S. Bureau of Mines officials from Butte and Salt Lake City arrived Saturday evening and Sunday. They immediately took charge of operations which necessitated the restoration of ventilation, and which at the time of their arrival had been advanced to the 1st west parting in the No. 3 vein, a distance of 7,000 feet from the mine portal. This advance was made by local crews and mine officials without the use of mine rescue apparatus.

The advance had been made possible because the force of the explosion did not reach the main fan at the mouth of the mine at the intake airway.

However, the 3 booster fans in the No. 3 vein were destroyed by the force of the explosion and the work of restoring the ventilation became increasingly more difficult and dangerous as only one of the booster fans could be replaced during the following week. The work of rebuilding the stoppings was exhausting and hazardous due to the presence of carbon monoxide in the mine atmosphere and every precaution had to be taken in order to safeguard the lives of the men engaged in recovery work.

Under the able supervision of the U. S. Bureau of Mines officials, Messrs. Arnold, Evans, Johnson, McCall, Bailey, Reeder and Denney ably assisted by Messrs. McElHatton of the M.S.A. Company and M. Mullen of the Atlas Powder Company the recovery of the bodies of the victims of the disaster was accomplished without injury to any of those engaged in the work.

The last body recovered was that of Elmer Price, mine foreman, on Sunday March 7th at 3 p. m. in room No. 12 in the 5th South East entry. The bringing of the body to the surface at 6 p. m. brought to a close one chapter in the greatest coal mine disaster in the history of the State.

The work of improving the ventilation continued with considerably reduced working forces during the following two weeks.

On Monday, March 22nd, the work of investigation to determine, if possible, the point of origin and the sequence of events that led up to the explosion commenced.

The U. S. Bureau of Mines was represented by O. G. Arnold and F. Bailey of Salt Lake City.

The State was represented by Ed Davies, State Coal Mine Inspector, Billings, and Ben Henry, State Quartz Mine Inspector, Helena, and Archie Browning of Great Falls.

The United Mine Workers organization District No. 27 was represented by W. A. Boyle, District President; J. Masini, International Board Member, and Joe Yanishein, District Board Member, and Joe Bosone, Secretary of Foster mine L. U.

The Montana Coal and Iron Co. was represented by W. A. Romek, Assistant General Manager, Thomas Freeman, outside foreman, Lorren Neuman and Martin Rapp, mine examiners.

These men were assisted by John McDonald, Alex McDonald, John Reed and Ira Maxwell, all of whom are employees of the Montana Coal and Iron Co. Their knowledge of the mine workings, and the mining practices and conditions together with their practical knowledge, was of value to all the investigators.

The investigators were at liberty to consult with each other or reach their own conclusions independently.

We are of the opinion that the determining of the point of origin of an explosion by noting the direction of its forces is far from being an exact science.

In many mines after explosions, the evidence has been conclusive as to the point of origin while in others it has been so confusing and contradictory that agreement in regard to it could not be reached by the investigators. Such was the case in regard to the point of origin of the Smith mine explosion. When the evidence is not clear the investigators reach different conclusions which are necessarily based upon assumptions and probabilities. The investigators quite naturally stress the points which appear to them to support their conclusions. Most of us cling tenaciously to our theories and assumptions.

Men with experience as investigators of mine explosions have made certain definite assertions which are generally accepted. We quote the following:

> "In determining whether an explosion was a purely gas explosion or dust explosion, it must be remembered that in a gas explosion it can only extend as far as the amount of gas exploded can expand. It must also be remembered that the afterdamp of an explosion invariably contains much carbon monoxide, which, owing to its wide explosive range is not as liable to be extinguished by the expansion and cooling in more open workings as Marsh gas is. This accounts for the phenomenon of what is termed the recoil or return flame of a dust explosion."

And also:

> "As the first explosive blast sweeps through an entry, it leaves behind it a trail of hot and generally inflammable gases, consisting chiefly of carbon monoxide and nitrogen. The immediate cooling of these hot gases, due to expansion, causes a depression or fall of pressure in the entry and ,as a consequence air rushes out from the rooms or other workings. Thus a fresh supply of oxygen is furnished, and the flame having been arrested in its advance by the increasing effect of the depression behind, or by its own expansion and cooling starts to turn back on its own trail."

It soon becomes evident that the explosion in Smith mine was not a purely gas explosion. Though gas may have originated the explosion by being ignited with an open light. It was the dust that propogated it through the workings of the mine.

There also was evidence that the explosion in some places had recoiled and traveled back over its original course.

The mine had been in production since the turn of the century. It was opened on the No. 2 vein and the main slope driven approximately due South, and dipping slightly in that direction.

The No. 3 vein, in which the explosion occurred, lies about 80 feet below the No. 2 vein and is entered through a rock tunnel which was driven from a point about 3,600 feet from the mine portal. The rock tunnel extends for a distance of 450 feet and continues the main haulageway to the face of the Main South entries for a total distance of 11,000 feet.

The 3 main entries in the No. 3 vein dip slightly towards the face, the middle entry being the main haulageway. The panel entries were driven East and West off the Main right and left back entries. The left panel entries were driven at an angle of 45 degrees, and the right panel entries at an angle of 90 degrees. The rooms generally were driven at an angle of 45 degrees off the panel entries at distance of 100 feet.

The faces of the rooms and entries were ventilated by line brattices.

The coal was top cut and center sheared. The vein being about 10½ feet thick. Coal varying in thickness from ten inches to eighteen inches was left to form the roof as the over-lying shale roof was difficult to support.

The working forces worked in crews or units. Each crew consisted of a loading machine operator and helper, one face man, usually two tracklayers, one timberman, and an electric locomotive haulage operator and a **nipper.**

Two cutting and shearing machines were operated by four men who did all the cutting and shearing of the coal preparatory to its being blasted. The two drilling machines were operated by four men together with two shot-firers who did the drilling and blasting for the entire mine.

The powder car was attached to the drilling machine, and while the drillers drilled the holes the shot-firers made up the charges and loaded and tamped the holes which were fired at the end of each shift.

Black pellet powder was chiefly used and was set off with fuse lit with on open light. Preparations were being made to use permissible powder and permissible detonators.

Closed electric battery lights and open lights were used by the employees. An order for additional electric lights had been placed by the company but owing to priority regulations they had not been delivered. The priority rating of the company was recently changed and delivery of the lamps was recently made.

The electrically operated cutting and loading and drilling machines used at the working faces were not of the permissible type.

The haulage from the working faces to the 1st West rope haulage parting was done by electric trolley line locomotives, and from that point to the surface by two electric rope haulage hoists. One of these was located in the No. 2 vein and the other outside the mine. All machinery was regularly inspected and kept in good condition.

The mine was ventilated by a main fan located at the intake portal of the mine and 3 booster fans in the No. 3 vein. The first booster fan was located in the main air course in by the air shaft that connects the No. 2 and the No. 3 veins. The second was located in the 8th South East back entry outby the first slant, and the third was located in the 4th South East in by the air shaft which connects the No. 2 and the No. 3 veins, in the return air course.

The mine was ventilated by one continuous current and the volume of air circulated was sufficient, if properly directed and controlled, to dilute and render harmless the amount of gas normally generated at the working faces. The last readings taken by the mine foreman (Price) and recorded in the mine office, shows that the lowest reading obtained in entry last cross cuts on February 23rd was 13,800 cubic feet per minute. The main fan delivered 43,470 cubic feet per minute.

The mine did not normally generate excessive volumes of methane. It was regularly inspected by certified mine examiners, and their reports were recorded in the mine office at the end of each shift in accordance with the provisions of the State mining laws. The reports, since the inspection of the mine in November, by the Federal coal mine inspectors, were signed by one or both day mine foremen. The mine foremen also inspected working places with safety lamps.

Due to the increased demand for coal on account of the National emergency the mine worked double shift.

The number of men employed was 257, and of that number 109 worked on the outside of the mine.

One mine superintendent was employed, three mine foremen, two on the day shift and one on the night shift. These officials were men whose experience in the Smith mine and neighboring mines in Carbon County ranged from 20 to 30 years. They were men who appeared to have confidence in their ability to carry out their duties in accordance with the provisions and requirements of the State mining laws.

By authority granted under the provisions of the Federal Coal Mines Inspection Act of 1941, federal mine inspectors inspected the Smith mine during

the latter part of November, 1942. Their recommendations are embodied in two reports. One, a preliminary report, which was posted at the mine immediately after the completion of their inspection, and a final report which was issued March 18th, 1943. Copies of the preliminary report were received by the management, the State coal mine inspector, and the District President of the United Mine Workers organization in December, 1942. As already stated the final report was issued in March, 1943.

Lacking police powers the Federal coal mine inspectors, under the direction of the U. S. Bureau of Mines, seek the cooperation of the State Mining Departments, officials of the United Mine Workers of America organization, the management and the men employed in the mines.

It is only through the close cooperation of all the above mentioned that the recommendations of the Federal Inspectors can be made effective.

In case the Federal mine inspectors find a condition in a mine which they consider to be an immediate menace to the lives of the men employed in the mine, and the mine management refuses to take immediate action to remove the danger, after it has been brought to their attention, it then becomes the duty of the Federal mine inspectors to notify the State coal mine inspector or the State department that controls the office of the State coal mine inspector, in order that the police power of the State may be exercised.

The Federal Coal Mine Inspectors who inspected the Smith mine during the latter part of November, 1942, did not consider the mine dangerous in the sense that the exercise of the police power of the State was necessary in order to make it reasonably safe.

The Federal Coal Mine Inspectors bring to their work the technical knowledge which they acquire through years of study, and the practical experience which they have gained as miners, mine foremen, mine superintendents, mine engineers and general managers of mines or groups of mines. In addition they receive intensive training at the U. S. Bureau of Mines station at Pittsburgh, Pa., before they are assigned to the various regional districts set up by the Bureau in order to facilitate the carrying out of the provisions of the Federal Coal Mines Inspection Act.

All of the major recommendations of the Federal Coal Mine Inspectors should be incorporated in our State mining laws as soon as possible in order to meet the changes that have resulted on account of modern mining methods and the mechanization of our coal mines.

RECOVERY OPERATIONS

Eleven of the bodies of the victims were found between the portal of the mine and the face of the Main South entry. This number includes the two found in the machine shop located between the 6th and 7th S. E. entries. The others were found in the order and the entries designated.

Between the portal of the mine and the face of the Main South entry. (1.2.3.4.5.6.7.8.9.10.11.).

5th West Main entry. On entr yat room No. 3. (12.13.14.15.16.17.). The men had walked about one thousand feet before being overcome by the afterdamp.

6th West Main entry. In room No. 2. All found within 25 feet of the face. (18.19.20.21.22).

7th West Main entry. On entry at room No. 3 (23). This man had walked from slant inby room No. 7, a distance of 600 feet before being overcome.

8th West entry. In a cross cut between rooms No. 3 and No. 4. (24.25.26. 27.28). They had moved but a few feet if at all. Between rooms No. 3 and No. 5 on the entry, (29.30.31.32.33.34.35.36.37.). They had walked varying distances up to 160 feet.

Main South Left back entry. (38.39.40.). Two of these were found at the face, one fifty feet outby.

9th South East entry. (41.42.43.). Two were found in room No. 5, and the other at mouth of room No. 6.

8th South East entry. (44.45.46.47.48.49.50.51.52.53.54.55.). Ten had walked variable distances to room No. 3, distances were from 1,600 to 2,000 feet.

7th South East entry. (56.57.58.59.60.61.62.63.64.65.66.). Ten men moved variable distances from 400 to 1,000 feet. Tracklayer at room No. 23 evidently did not move.

5th South East. (67.68.69.70.71.72.73.74.). Five men moved variable distances up to 600 feet. Some of these wrote farewell messages to their relatives. It is estimated that 55 men had moved variable distances and that 19 apparently did not move.

In an effort to determine (if possible) the point of the origin of the explosion in the No. 3 vein.

Smith Mine No. 3 vein, Monday, March 22nd, 1943

Starting point:

2nd West panel entries.

No men were employed in these entries on the day that the explosion occurred. Direction of the force of the explosion uncertain. No indications of any significance. Clear of gas a 2nd cross cut.

3rd West panel entries.

Indications of gas. Direction that explosive forces traveled uncertain. No men were employed in these entries on February 27th, date of explosion.

4th West panel entries.

Forces of explosion traveled East to West and West to East. Stoppings between the main and back entries, indicated that forces traveled North to South. Evidence of intense heat in rooms. At the face of the main entry there was a trace of gas. Canvas opposite last cross cut burned to ash. Pump at 2nd cross cut from the face but no motor attached. The door in the slant between the Main South East middle and right back entries was blown West to East.

No men were employed in the above mentioned entries and after considerable checking of the directions that the explosive forces traveled, they were eliminated as probable points of origin of the explosion.

Smith mine No. 3 vein, Tuesday, March 23rd, 1943

Starting point:

5th West Panel entries.

Between rooms No. 6 and No. 7, stoppings between the main and back entries was intact. Force of explosion traveled from North to South. At room No. 10 on main entry clear of gas. Room No. 11 clear of gas. Explosive mixture, on top of cave 80 feet from entry face Loading machine at room neck of room No. 12. Controls in off position. Force of explosion in last slant North to South. The door in the dip workings was intact. Motor with empties servicing the loading machine. Room No. 1 in dip workings clear of gas. The cross cut to room No. 2 not completed but clear of gas. Six loaded cars on parting near South of main entry. Trolley wire hanger showed that the force of the explosion had traveled East to West. The five men in this entry had walked from room No. 12 inby to room No. 3 outby on the main entry a distance of approximately 1,000 feet. There were no signs of heat. The door in the 5th west slant between the Main S. E. middle and right back entries was blown East to West. The force of the explosion in the air course between the 5th and 6th West entry panels traveled North to South.

6th West panel entries:

In the main entry the force of the explosion traveled East to West. Cutting machine in room No. 2. Water tank blown off the top of the machine North to South. There were indications that the explosive force had first traveled to the face of the room and then back over its path. The bodies of the 5 men found in room No. 2 were burned. Safety lamp test showed no gas. Force of the explosion traveled East to West in the back entry. Air reading taken in the intake airway between the 6th and 7th West panel entries, 4,800 cubic feet per minute.

7th West panel entries:

In room No. 5 explosive gas found but no indications of heat. Cap and lamp and a coat found at second slant from main entry face, the coat was almost completely burned. The cap and lamp and coat belonged to the man who was found outby on entry at room No. 3. He had walked approximately 600 feet. He was building a stopping in the slant, where his lamp and cap and coat were found, at the time that the explosion occurred. He had found his way without light the distance of 600 feet that he had walked to room No. 3. The 7th West slant door between the Main South middle and right back entries was blown East to West. In the Main South Right back entry, which is the intake airway of the No. 3 vein, between the 7th and 8th West panel entries evidence of heat was found and little evidence of force.

Of the panel entries mentioned above the 7th were given considerable attention during the following weeks by checking and rechecking the directions in which the explosive forces had traveled through them. They were later eliminated as the probable source of origin of the explosion.

Starting point:

8th West panel entries:

There were indications that the forces of the explosion had traveled East and West on the Main entry, and both North and South in the cross cuts or slants between the entries. In room No. 1, the tracklayers' tools and dinner pails were found. Preparations were being made to lay a switch. The fire boss' report (Neuman's) showed traces of gas in the room on his early morning inspection on February 27th. His report was the last recorded. He had dead-lined room No. 1. The deadline had been removed and it is assumed that the gas had been removed by the day shift officials before the track layers entered the room. The tracklayers were not in the room at the time of the explosion. Room No. 2 had also been deadlined by Neuman on his early morning inspection February 27th. The deadline in this room had also been removed. His report shows an explosive mixture at the face of room No. 2 and the same in a slant or crosscut being driven outby to connect with room No. 1. The crosscut had not been completed. A crosscut, or slant, being driven from No. 2 room to connect with room No. 3 had been holed through at the face on the left side. The hole had been enlarged by Neuman on his morning inspection and he traveled through it to room No. 3 where he found an explosive mixture at the face. There is a cave of roof in No. 3 which Neuman did not cross. Before passing through the crosscut to room No. 3 he examined for gas at the face of the crosscut and found it clear. At the time of our inspection we found it clear of gas. The loading machine was in this cross cut at the time of the explosion. Three of the five men were found near the machine used open lights. The machine crew had loaded 12 cars of coal out of the cross cut, and this fact clearly proves that there could have been no body of standing gas in the crosscut when the crew first entered it. The cutting machine was found in room No. 5 "sumped in," with the controls in the off position. The cutting in Smith mine was top cutting, the coal being cut near the top of the vein near the roof, and not near the bottom of the vein next to the floor as is the practice in the other mines in the State. The Main entry had been cut and center sheared, as had also a slant being driven to the left near the face of the entry.

In room No. 5 the cutting machine had been "sumped in" near the roof at the left side of the face. On our inspection we found explosive gas in the top cut in the entry, and the same in room No. 5, and indications of gas in the slant being driven to the left to connect with the Back entry. It is, we believe, significant that the fire boss' report (Neuman's) does not report any gas being found in any one of the three places when he inspected them before the day shift entered the mine on the morning of February 27th, the day that the explosion occurred. A brattice had been erected the day before outby the last slant or cross cut that connects the Main and Back entries, and a line brattice extended from that point, to the mouth of room No. 5 inby a distance of 42 feet. There is a cave in the Back entry between the third and fourth slants from the face. When the cave occurred we do not know. The distance from the end of the line brattice at the mouth of

room No. 5 to the face of the Main entry is 102 feet, and the distance to the face of room No. 5 is sixty feet.

The brattices were blown outby, and the indications were that the explosion gathered force as it traveled towards the mouth of the Main entry.

The stoppings between the Main and Back entries were blown, some North and the others South. The stopping in the Main air course between the two 8th West panel entries was blown South, and the door in the 8th West slant was blown outby and found in the Main S. E. middle entry. The stoppings in the two slants, between the Main South middle entry and the Main air course, outby, were blown in the same direction as the door.

The two machine men who cut the places referred to in the 8th West Main entry, the face of the entry, and the slant being driven to the left to connect with the Back entry, and room No. 5 where the machine was sumped in, used electric battery closed lights. They were found on the entry outby between rooms No. 5 and No. 4.

One of the tracklayers who had made preparations to lay a switch in room No. 1 outby, was found on the entry at the mouth of room No. 5. He used a open carbide light. It is assumed that he had left room No. 1, and proceeded along the entry towards the face in order to obtain material to be used in connection with the laying of the switch in room No. 1. Whether he had traveled inby the point where his body was found, either towards the face of the entry or into room No. 5 could not be determined.

9th West panel entries:

There were indications that the explosive forces had traveled East and West. Explosive mixture was found at the face of the Main entry. Back entry face, holes loaded and ready to shoot. Explosive mixture at the face. Face of slant next to the face in Main entry loaded and ready to shoot. Powder box between entries in Main course blown 35 feet South, powder intact. The door on the Main S. E. middle entry was blown South by initial force of the explosion. There was evidence of intense heat between the 8th West and 9th West panel entries in the air course. The door in the 9th West slant indicated that parts of it had been blown inby and parts of it outby.

Main South East entries:

There was very little evidence of force in the Middle, and Right back entries. The face of the Middle entry and a slant just in a few cuts outby had been drilled and the holes charged and ready to shoot.

Main South East, Left Back entry:

Face of the entry clear of gas. Drilling machine with powder car attached near the face. Powder car on morning of February 27th contained pellet powder, Monobel powder and electric detonators and a coil of fuse. Some of the detonators exploded in the cars and the powder and fuse were burned. The powder car was not badly wrecked. The cover of the car was found outby a short distance. Two men were

drilling a hole at the face at the time of the explosion, their caps and electric battery lamps were blown towards the face of the entry. The third member of the crew was the shot-firer who was preparing a charge. He was badly burned. The two men who were drilling at the face were not burned. It was estimated that the powder car contained from 100 to 150 pounds of powder. A powder box in the 2nd slant outby was blown apart but the three cases of pellet powder that it contained were intact.

The burning of the powder provided the necessary elements which enabled the initial explosive force to recoil and travel back over its path.

The powder car was eliminated as the probable source of the origin of the explosion as the three men used electric battery closed lights, and the shot-firer was a non-smoker. The evidence indicated that he was handling a detonator at the time of the explosion but his hands were not injured.

11th South East panel entries:

There were indications that the force of the explosion traveled towards the faces of both the Main and Back entries. There was an explosion mixture 200 feet from the face of the Main entry. There was evidence of heat in both entries. No men were employed in the 11th S. E. on February 27th.

10th South East panel entries:

The stoppings in the slants between the Main and Back entries were blown North. The stopping in the Main S. E. Left Back entry that forced the air current into the 10th S. E. Back entry was also blown North. The sand box directly opposite this last mentioned stopping was blown South. And the door in the slant immediately to the left was blown East. Explosive mixtures were found in rooms Nos. 1, 2 and 3. There was evidence of heat 200 feet from the faces of both entries. There were no employees in these entries or rooms on February 27th.

9th South East panel entries:

The evidence indicated that the initial force of the explosion traveled inby or East in the Main entry. The stoppings in the slants between the entries were blown some North and others South. In room No. 5 an explosive mixture was found at the face. There was also evidence of heat and great force. A cross cut 160 feet from the face of the room connected rooms No. 4 and No. 5. The direction of the explosive force in this cross cut was from West to East. Two tracklayers were found in this room, one inby the cross cut at the face on top of the coal that had been shot down. His track hammer and a part of a shovel, the spike bucket, pieces of canvas, a cap piece, and smaller pieces of wood were also found on top of the coal. The other tracklayer was found outby the cross cut. The evidence indicated clearly that the explosive force traveled through the cross cut from room No. 4 to room No. 5 and then North and South in room No. 5.

One of the mine foremen (Murray) was found at the mouth of room No. 6 on the entry. His safety lamp was found intact 39 feet inby room No. 6 near to the face which had been shot down. The date and the initials of the night fire boss (Mickeljohn) are indistinct in room No. 5 but they are clear and distinct in room No. 6. The map of the 9th South East panel entries and room, with arrows to indicate the direction of the explosive force, which we are forwarding with this report is not in agreement with that of the Federal mine inspectors. Their map shows the explosion originating at the face of room No. 5 and its force being propagated throughout the mine from that point. We have a duplicate of their map with arrows indicating the directions of the explosive forces and other data. Very few of the investigators accept the view that the explosion originated at the face of room No. 5.

Thursday, March 25th, 1943

Starting point:

8th South East panel entries:

The direction of the explosive force was from West to East in both entries. The booster fan in the back entry was blown inby a distance of 235 feet. A 20 ton motor in the Main entry at room No. 2 was blown off the track. The stoppings in the slants between the entries were blown North. The stoppings inby room No. 8 were intact. There was no evidence of force beyond that point inby for a distance of 1,500 feet. The loading machine was found 100 feet from the face of the Main entry. The haulage motor with 8 loaded cars was between rooms No. 16 and No. 17. There was moisture from room No. 17 to the face of the entry and no evidence of violence. At the break-through to the 7th South East Back entry at the face of room No. 10 the direction of the force of the explosion was from South to North.

7th South East panel entries:

The force of the explosion traveled East in the back entry towards the face. From room No. 17 to the face the Main entry was wet. The stopping outby had been blown in different directions. Rooms No. 17, 18, 19 and 20 contained explosive mixtures, but there was no evidence of heat. The loading machine was in room No. 18. The fire boss (Micklejohn) was found on the entry at room No. 18. His safety lamp was intact. The haulage motor with two cars partly loaded with rails and ties was near the face of room No. 20. There was a coat partly burned on the entry at room No. 18. There were 4 loaded cars on the entry between rooms No. 18 and No. 19. The controller on the loading machine in room No. 18 was open and the nips on the feeder wire. Outby at the mouth of the entries the explosive force traveled from West to East. At the break-through to the 6th South East panel entries at the face of room No. 6 the explosive force traveled North.

6th South East panel entries:

Explosive force traveled North at break-through to 5th South East Back entry at the face of room No. 4. Operations had been discontinued in 6th S. E. panel entries and rooms, and track taken out. There were no indications of any significance.

2nd South East entries:

The door in the slant was intact. The line brattice in the Back entry was blown inby. Five bodies were found inby the slant connecting both entries. There was no evidence of heat or violence. These men had erected a brattice in an attempt to barricade themselves in. They wrote messages to their relatives. They were alive at 11:05 A. M.

5th South East panel entries:

Explosive gas was found at the face of the Back entry. The loading machine was found at the face of the Main entry with controls in the off position and the nips on wire. The roadway near the face of the entry was wet. In room No. 12 the body of one of the mine foremen was found about 80 feet inby from the entry. His lamp was found intact in the middle of the track nearby. At the top of the air shaft between rooms No. 9 and No. 10, one per cent of gas was found. The 5th S. E. fan was blown outby 12 feet from its base.

Friday, March 26th, 1943

4th South East panel entries:

The explosive force traveled from West to East inby the junction point with Main South East and traveled West outby. In the 2nd North entries driven off the 5th S. E. entries two 12 inch concrete stoppings were blown towards the face. The 4th S. E. and 2nd North entries and rooms are old workings with track removed. There was a pump in the 1st North Main entry that required attention and that was the only work performed. The air shaft connecting the No. 2 and the No. 3 veins is in the 1st North Back entry outby the Main 1st S. E. entries. Part of the return air current reaches the No. 2 vein through the air shaft and the remainder reaches it by traveling on the 5th S. E. entries and then over the Main haulage way.

Saturday, March 27th, 1943

1st West Parting:

Explosive force traveled East to West. There was a 20 ton motor or locomotive at inby end of the parting with six loaded cars attached. One of the cars was turned on its side. The cover of the motor was blown outby. There was a small cave of roof near the cars. There was evidence of heat outby on the Main haulage road.

Monday, March 29th, 1943

Starting point:

Main South East entries:

The evidence and indications in these entries in regard to the directions the explosive forces traveled are so conflicting and contradictory that no other statement in regard to them can as adequately and satisfactorily explain them.

Tuesday, March 30th, 1943

Several entries and rooms were reinspected with the view of rechecking previous observations. These were the 8th West entries and rooms, and the 9th South East entries and rooms No. 4 and No. 5 and No. 6.

As a result of our investigation we have concluded that the explosion originated in the 8th West Main entry at a point inby the brattice that had

been erected across the entry and continued inby to the mouth of room No. 5. The cross sectional area at the end of the line brattice was 12 square feet, and the distance from the end of the line brattice to the face of the entry is 102 feet, and to the face of room No. 5, 60 feet.

These places, as previously stated, were cut by the machine men on the morning of the explosion, and on our inspection nearly a month later two of them, the entry and room No. 5, were still giving off explosive gas, and a test revealed a trace of gas in the third, the slant being driven to the left, near the face of the entry. There is a cave in the Back entry between the third and fourth slants from the face which fills the entry and cannot be crossed. We do not know when the cave occurred, but if it occurred on the morning of February 27th it would have greatly reduced the quantity of air entering the 6th West Main entry. The fire boss' report (Neuman's) for the morning of February 27th does not show gas in any of the three places, the entry, the slant being driven to the left near the face of the entry, and room No. 5 where the machine was "sumped in."

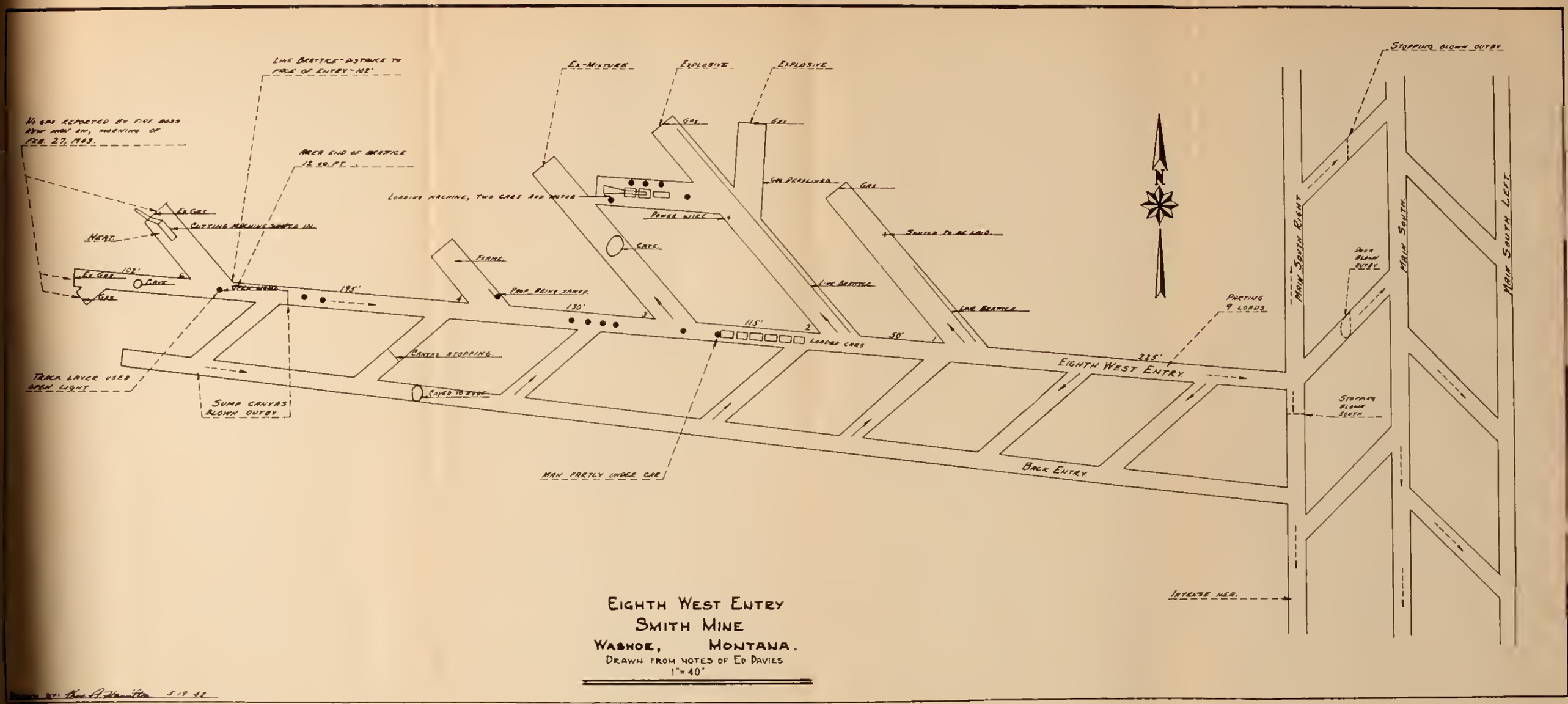
The two cutting machine men used closed lights which could not ignite the gas that the cutting had released in the three places, but one of the tracklayers who were going to lay a switch in room No. 1 outby, was found inby the point where the brattices had been erected across the entry on February 26th. The tracklayer used an open carbide light. The brattice was blown outby and the explosion gathered force as it traveled along the entry to the Main air course and the 8th West slant. It traveled both North and South in the Main air course, and blew the door in the slant outby on to the Main South entry.

As previously stated the determination of the point of origin of an explosion, by noting the directions which the explosive forces traveled, is far from being an exact science as it involves assumptions and probabilities. However, most of the rooms and entries in the mine were eliminated as possible points of origin by all investigators. The process of elimination continued until but a few places remained, and of these the 8th West Main entry appeared to us, as the result of the evidence we obtained and our personal observations, to provide the answer as to the point of origin of the explosion. The majority of the investigators accepted our conclusions.

About fifty men are now being employed in the No. 3 vein removing machinery, track and other equipment. The company has decided to abandon the mine. A new opening from the surface to the No. 2 vein has been started, and this will eventually provide employment for all the employees who are now idle as a result of the disaster.

Respectfully submitted,

STATE COAL MINE INSPECTOR.
STATE QUARTZ MINE INSPECTOR.



Eighth West Entry
Smith Mine
Washoe, Montana.

Drawn from notes of Ed Davies
1" = 40'

Drawn by: [illegible] 5-19-43

COAL MINE INSPECTION DIVISION

Salt Lake City, Utah, May 17, 1943 GOA:DA

MEMORDANDUM for R. D. Reeder:

I have read with interest the report of State Coal Mine Inspector Davies covering the explosion on February 27 at the Smith mine, Montana Coal & Iron Company, at Washoe, Montana. There are several statements in his report which I should like to discuss; they are:

In the ninth paragraph on page four reference is made to the quantities of air circulated through the last crosscuts of the several panels. A copy of the air readings taken by the mine foreman during the period of November 12, 1942 to February 25, 1943, is attached for reference. Unfortunately, readings were not taken in the intake airway outby the first working panel, so no positive evidence is available as to the effective volume of air in circulation. At the time of the Federal inspection in November 1942, a volume of 21,600 cubic feet of air per minute, or less than half the volume entering the mine, was measured in the intake airway at a point opposite the 5 southeast panel. Unless the actual volume of air passing this point had been increased substantially, as a result of the repairing of leaky stoppings and doors, a portion at least of any increases measured by the foreman may have been due to recirculation of air by the booster fans, or to the difference in the tightness of stoppings and doors in panels from week to week.

On page 10, in the third paragraph, reference is made to the shot-firer at the face of the left back entry, of the main south entries, possibly having been preparing a charge and using detonators. A cap crimper was found on the floor near his hand. This assumption was dismissed by Bureau investigators as black pellet powder was being used in all places at the time. The other two entries had been drilled that morning and the holes charged with pellet powder. The cap crimper had no doubt been on the "powder" car, and when thrown off, or out, by the force of the explosion, happened to fall near the shot-firer's hand. Some electric detonators found near the car had no doubt been left by representatives of an explosive's manufacturer, who had been making tests in the mine. There was no evidence of permissible explosives having been in the "powder" car at the time of the explosion.

On page 11, in the third paragraph, in the discussion of the 9 southeast panel, a statement is made in reference to the crosscut between room No. 4 and room No. 5—" . . . The direction of the explosive force in this crosscut was from west to east." This statement is positively in error, as a mine car was standing on the track in this crosscut, near the point where the crosscut broke into room No. 5. The bumper and drawbar on the end of the car facing room No. 5 were packed with debris, and there were other indications that the force of the explosion passed from room No. 5 through the crosscut into room No. 4.

As to the statement on page 11, in the fourth paragraph, that—". . . Very few of the investigators accept the view that the explosion originated at the face of room No. 5.", would refer to the personnel of the investigating committee. Mr. Archie Browning represented Mr. Davies and accompanied the Bureau investigators throughout. He entered into the discussions and agreed as to the directions of the forces established on the map submitted with the

final report of the Bureau representatives. None of the others were familiar with the discussions or with the details of the study to establish the direction of forces.

On page 12, in the discussion of the 2 southeast entries off the 5 southeast panel, reference is made to an attempt of the 5 men found there to erect a barricade. A brattice-cloth curtain was found across the entrance to this place. The forces of the explosion did not extend to this point, and this curtain was no doubt used to divert the air current through other openings down to the faces of the 2 south slopes. Crosscuts, or slants, open to the place where these men were found, were open to the movement of air and no attempt had been made to close them. Had these men seriously attempted to barricade themselves they would have closed the openings to the two slants and they would have constructed a tight brattice across the entrance to the slope, instead of a loosely hung curtain.

In the last paragraph, on page 14, reference is made to the abandoning of the workings in No. 3 bed. The management decided that the cost of rock dusting the present workings would be great, that the length of haul was now excessive, and that they would make a new opening in No. 3 bed from the surface. Work was underway toward this end prior to the explosion. The new openings are down the canyon about 2,000 feet from the present mine portal in No. 2 bed.

I believe the discussion herein will clear up the questions that may arise from comparing Mr. Davies' report with that of the Bureau investigators.

(Signed): G. O. ARNOLD,
Senior Coal Mine Inspector.

Billings, Montana

July 10, 1943

TO GOVERNOR FORD'S COMMITTEE INVESTIGATING SMITH MINE EXPLOSION

Gentlemen:

We have received copy of the Coroner's Jury verdict in regard to the explosion at the Smith Mine on February 27, 1943, together with the Jury's recommendations pertaining to amendment to the Montana State Mining Laws. We have also received copies of reports relating to the explosion at the Smith Mine from the U. S. Bureau of Mines, Montana State Coal and Metal Inspectors, and from the Montana Coal & Iron Company.

These reports offer suggestions pertaining to amendments in the State Mining Laws. Before any recommendations are definitely offered to the Governor, it is our suggestion that the existing State Mining Laws and laws pertaining to safety provisions as contained in "Safety Provisions of Workmen's Compensation Act," be reviewed to ascertain whether or not the suggestions received are already covered and included in the laws currently existing.

RECOMMENDATIONS OF THE CORONER'S JURY

"1. That the State and Federal Coal Mine Inspectors be given power to close any mine or part thereof where said inspector finds any hazard that he considers dangerous to the health and safety of employees."

In this connection we call your attention to Section 3450 of the Montana State Mining Laws pertaining to "Powers and duties of inspector." We suggest that this section 3450 be amended by inserting in the fifteenth line thereof the word "hazardous" after the word "any," and eliminating the last word of that line, "respecting," and the first word of the following line, "ventilation." The sentence beginning in middle of fifteenth line will then read:

"If the inspector finds any hazardous condition in any part or portion of said mine in violation of the regulations provided in such Act, he shall confer with the management of the mine, in regard to such condition."

We further recommend the elimination of the words "respecting ventilation," appearing in the nineteenth line of said Section 3450, and permitting the balance of the Section to remain unchanged. In accordance with the remainder of the section, it then becomes the duty of the operator to correct the faulty condition within the time limit agreed to between inspector and operator. Otherwise the inspector can close the mine.

Further in connection with this recommendation No. 1, we refer you to Section 3021 of the Safety Provision Laws of Montana, also administered by the Industrial Accident Board, entitled, "When Board or inspector may order place of employment closed and put in safe condition." This states that if after inspection, the Board or any inspector shall find a place of employment in an unsafe condition, such as to constitute an immediate menace to the safety of workmen employed, the Board or any inspector or examiner thereof, may order such place or employment closed. Sections 3025 and 3027 also deal with places of work considered unsafe.

With the amendments above suggested, we are of the opinion that Section 3450 of the State Mining Laws and Sections 3021, 3025, and 3027 of the Safety Provision Laws will adequately provide for the protection requested in the aforesaid suggestion No. 1.

"2. That blasting of coal be not permitted when men are working in the mine unless permissible powder is used."

Members of the Montana Coal Operators Association have no objection to this recommendation.

"3. That every underground employee be furnished with self rescue equipment."

"4. That helmets and gas masks in workable condition, in sufficient quantities, be kept at the mine to supply rescue crews in case of emergency."

"5. That rescue crews be trained to rescue work and be supplied with all necessary equipment."

The members of this Association are earnestly considering these three recommendations, Nos. 3, 4, and 5. However, until more is learned regarding the most practical procedure to follow, they will not be ready to offer suggestions. They also desire to be better informed on the mining laws and laws pertaining to safety provisions existing in neighboring states. However, the Operators have a suggestion relative to Recommendation No. 4. As the recommendation now reads, helmets and gas masks are to be kept at the mine. This could be interpreted to mean that each mine should provide itself with complete mine

rescue and first aid equipment. The Operators believe that this is clearly unnecessary where two or more mines are in the same immediate locality. This work can be centralized for that locality, both as to training and equipment, this would result in a more moderate expense burden than if each company was obliged to keep and maintain complete equipment. For example: One group of Montana mines is located in the Bearcreek-Washoe Field; another group is located in the Roundup Field. The Giffen area would constitute a third group. Each group could develop its own program. We believe the Committee will be in full accord with these suggestions.

"6. That all coal mines be rock-dusted."

The Operators are opposed to the recommendation that all mines be rock-dusted. We believe there are many mines in the State where rock-dusting is not ncessary. We believe in rock-dusting where it is actually necessary but we also believe that a law should not be passed making it obligatory for all mines to comply with this suggestion.

We believe that Section 3514 of the State Mining Laws provides for rock-dusting when necessary. This section directs that where coal dust or other inflammable material may accumulate, the same shall be properly saturated with water or with some compounds, or chemicals used for such purposes **as often as may be necessary.** This permits the Mine Inspector to direct rock-dusting when it is necessary.

"7. That ventilation systems be improved immediately when requested by mine inspectors, and that booster fans be discontinued."

We believe that the present laws pertaining to mine ventilation and ventilation systems, Sections 3501-3506, inclusive, cover the intended objectives of this Recommendation No. 7. We also believe that it would be a mistake to decide that all booster fans be discontinued. We believe booster fans serve a definite purpose, and we are of the opinion that it would be unwise to legislate prohibiting their use.

"8. That a competent employee, selected by employees, must also accompany the State mine inspector on his official mine inspection."

We believe this is a matter to be left to the discretion of the State Mine Inspector.

"9. That the intake air system should be on the man-way or haulageway when the mines have regular man trips."

We are definitely opposed to the inclusion of this recommendation in the State Mining Laws. Introduction of the ventilating system through the man-way or haulageway in the winter time would result in the formation of masses of ice at the portal and for several hundred feet inby, producing a situation dangerous to the employees and a serious transportation hazard. In many cases it would prevent rope rider riding a trip. Employees would be subject to dangerous cold air currents. It would result in deterioration and breaking up of the formation above the haulage-way, causing excessive falls and needing constant lagging and attention.

"10. That each local union of the mine involved be furnished a copy of each mine inspector's report."

We have no objection to this recommendation.

RECOMMENDATIONS OF THE U. S. BUREAU OF MINES

On Page 31 in the final report of the mine explosion at the Smith Mine made by the Bureau of Mines, it is recommended that reasonable protection against gas and dust explosion hazards can be obtained by compliance with the recommendations included in the preliminary report of its November inspection.

We have a copy of the Bureau of Mines preliminary report of the inspection of the Smith Mine, which inspection was made between November 19 and November 30, 1942. We do not believe it is sound practice to make amendments to the existing State Mining Laws that are based solely upon conditions and practices in one mine. So far as this Bureau of Mines preliminary report of the Smith Mine inspection is concerned, many of the recommendations therein contained are already covered in our State Mining Laws and laws pertaining to safety provisions.

The matters of mine ventilation and air at working places are fully covered by present laws, Sections 3501 to 3506, inclusive, also the matter of gas is included in existing laws. The Bureau of Mines preliminary report dwells on control of coal dust and the matter of rock-dusting. We have already covered these items in our earlier remarks, pertaining to the recommendations of the Coroner's Jury.

The Bureau of Mines preliminary report considers the matter of explosives. It states that the company should consider using a permissible type of explosive in place of black powder in blasting coal. We have already stated that the Operators are not opposed to the use of permissible powder in blasting while men are working in the mine. The Operators do not believe that the use of black powder in all of the coal mines in the State should be prohibited. It has been used here for fifty years. We believe that local conditions should govern and the good judgment of the Operator and Mine Inspector be employed. The subject of explosives and handling thereof is covered in Sections 3521 to 3524, inclusive, of present State Coal Mining Laws.

The subject of discharging shots is an important one. Before any changes are made in existing laws pertaining to coal mining in this State, we recommend that a survey be made to determine whether or not any change should be introduced. As in the case of the Bureau of Mines recommendations in the aforesaid preliminary report pertaining to ventilation, most of the suggestions regarding the use of explosives are already covered by our present laws. Section 3521, we believe provides adequate provisions regarding the storing of explosives. We believe wooden tamping bars should be used, and also believe in the Bureau's recommendations pertaining to stemming.

We believe that the recommendations in the Bureau's preliminary report regarding wiring and guarding of moving machinery parts are already covered in our laws pertaining to safety provisions, Section 3020.

We believe no new laws are necessary regarding timbering in mines. Ordinary safety practice cover this, and it is covered in Section 3525 of State Mining Laws.

Regarding the subject of haulage-ways, roadways, etc., the Operators fully believe that good tracks should be maintained and ample clearance for transportation provided, and proper attention given to the condition of the roof. Existing mining laws require no amendments to take care of these matters.

We approve of the use of safety caps and closed lights. We also approve of the use of safety shoes and goggles. We agree that adequate first aid dressings and materials should be available in the mine. Smoking in the mine should be prohibited.

We agree with the Bureau of Mines report that the practice of men jumping off man trips while the cars are in motion should be prohibited.

Regarding the Bureau of Mines recommendations in the preliminary report covering surface hazards, we believe safety provisions of present laws amply provide.

We believe in the use of safety caps and goggles for surface employees, where necessary.

REPORT OF THE STATE MINE INSPECTORS, DATED MAY 3, 1943, PERTAINING TO THE EXPLOSION AT THE SMITH MINE

On page 5 of this report of the State Mine Inspectors in the last paragraph thereon, the inspectors recommend that:

> "All of the major recommendations of the Federal Coal Mine Inspector should be incorporated in our State Mining Laws as soon as possible in order to meet the changes that have resulted on account of modern mining methods and the mechanization of our coal mine."

We have already expressed our views on the recommendations contained in the Federal Coal Mine Inspector's reports. As stated, we do not think it sound practice to base changes in the existing laws upon the experience or practice at one mine. We do believe that existing State Mining Laws are fairly complete and in need of little change. We believe that careful study should be made before changes are definitely recommended. As to any recent changes in mining methods, it should be stated that the major mines in Montana were modernized and mechanized approximately fifteen years ago.

REPORT OF THE MONTANA COAL & IRON COMPANY

We particularly call your attention to two recommendations made by this company. On Page 17 of the report of said company, it is recommended:

"1. That before suggesting coal companies block-off places that can accumulate considerable quantities of explosive gas, the Federal examiners should take into account, that falls of rock and squeezes might release this gas quickly in dangerous amounts and cause an explosion, and they should also recommend to the coal operators that double concrete stoppings and other precautions be taken to prevent this extremely dangerous source of explosion from causing disasters in the future, **especially in mines where they know that open lights, trolley mine locomotives and non-permissible electric equipment are being used,** as was the case at the Smith Mine.

"2. That Federal mine examiners should be very careful in suggesting to coal operators that ventilation improvements be made, that will have a tendency to dry out a mine and increase a coal-dust hazard, before rock-dusting equipment can be made available, **especially in mines where open lights and non-permissible electrical equipment are used,** or cannot be procured for an indefinite length of time, as was the case at the Smith Mine."

We believe that, generally speaking, Montana State Mining Laws compare favorably with those of other states. As earlier stated, before any changes in these laws or laws pertaining to safety provisions are recommended, we believe careful consideration and study should be given. If any changes are made, it is of utmost importance that they do not dangerously affect other conditions at the mine which might result in hazards. Close cooperation between inspector and operator is desirable at all times.

Thus far in this statement, we have considered only the situation pertaining to the members of the Montana Coal Operators Association and their respective mines. It should not be overlooked that in addition to these mines there are approximately 120 smaller coal mines in the State, usually known as truck mines. Only recently there were 180 of these small mines operating in the State. Their number has been reduced due to shortage of manpower. Montana State Coal Mining Laws and Safety Provisions apply to these mines as well as to the larger mines. Many of the provisions recommended would call for financial investment beyond the means of most of these smaller coal operators.

Respectfully submitted,

MONTANA COAL OPERATORS ASS'N,
D. F. Buckingham, Secretary.

VERDICT OF JURY

STATE OF MONTANA,)
) ss.
COUNTY OF CARBON,)

AN INQUISITION Taken at Red Lodge in the County of Carbon, on the 12th, 13th and 14th of April, A. D. 1943, before Edward Olcott, Jr., Coroner of the said County of Carbon, upon view of the bodies named on the attached list, lying there dead, by the oaths of the Jurors whose names are hereto subscribed, who, being sworn to inquire, on the behalf of the State of Montana when, how, and by what means, the said persons came to their deaths, upon their oaths do say:

That on February 27th, 1943, at the coal mine of the Montana Coal & Iron Company located at Washoe, Montana, met their deaths due to concussion and to gas poisoning caused by gas and dust explosion.

As a part of this verdict, we, the jury, impanelled on the coroner's jury recommend that our present mining laws be amended and new laws be enacted as follows:

1. That the State and Federal Coal Mine inspectors be given power to close any coal mine or part thereof where said inspector finds any hazard that he considers dangerous to the health and safety of employees.
2. That blasting of coal be not permitted when men are working in the mine, unless permissible powder is used.
3. That every underground employee be furnished with self rescue equipment.
4. That helmets and gas masks in workable condition, in sufficient quantities, be kept at the mine to supply rescue crews in case of emergency.
5. That rescue crews be trained for rescue work and be supplied with all necessary equipment.
6. That all coal mines be rock-dusted.

7. That ventilation systems be improved immediately when requested by mine inspectors, and that booster fans be discontinued.

8. That a competent employee, selected by employees, must also accompany the State mine inspector on his official mine inspection.

9. That the intake air system should be on the man-way or haulageway when the mines have regular man trips.

10. That each local union of the mine involved be furnished a copy of each mine inspector's report.

IN TESTIMONY WHEREOF, The said Coroner and Jurors of this inquest have hereunto set their hands, the day and year, to wit, this 14th day of April, A. D. 1943.

C. F. CHAMBERLAIN,
EDWARD BLOOM,
ELI PEKICH,
J. J. GERONDALE,
CELESTE ROAT,
JOHN MIKESELL,
JOHN MANCE,
ANTON COLUMBUS,
WILLIAM C. GODINA,

JURORS.

ATTEST:
EDWARD OLCOTT, JR.,
Coroner of Carbon County, Montana.

Frank Mourich
Jack Philip Mourich
Emil Anderson
William DeBourg Sr.
Leland J. Cline
William Mathew Pelo
Jules Besinque
Clement Scarr Lodge
Andrew G. Jordan
John Sommerville
William C. Appleton
Abe McDonald
Ferdinand Rasborchek
Robert Lee Wakenshaw
Clarence Carlye Williams
William Pryde
Frank Pajnich
Sam Barovich
John Germanetti
Adam Wakenshaw
Richard Mallin
Ignac Marinchek
Lloyd Williams
Marcel Fages

Admiral Dewey Hardy
Martin Ratkovich
Pete Giovetti
Joe Meyer, Jr.
John Sudar
Matt Hallila
James Hawthorne
William Noble
John Bone
George Thomson, Sr.
August Dervelle
William Shepard
Frank Sumisek
Louis Kuhar
David Sommerville
Edward Laird
James McNeish
Lawrence Reid
William A. Nelson
Sam Alexander
Earl Mus
Joe McDonald
Mike Korinko
John Meiklejohn
Robert McDonald

David B. Reid
William Beeney
Robert Whitehead
Patrick Doran
William Slaby
John Maden
Edward J. Laird
John Krop, Sr.
Edward Kumpula
George J. Saarela
Frank Starkovich
Joe Ferro
Walter Joki
Wilbur Muller
Herman Mejean
John Hodnik
Wayne Jones
Art Halpin
James Allison
Vic Zaputil
David J. Davis
Eino Rahkola
William N. Barry
David Murray
Elmer Price

Report on a Mine Explosion That Occurred at the Smith Mine, Washoe, Montana on February 27, 1943

MONTANA COAL & IRON COMPANY

Billings, Montana

June 10, 1943

Prepared by

J. M. FREEMAN,
Vice President and General Manager

W. A. ROMEK,
Assistant Manager

MONTANA COAL AND IRON COMPANY'S REPORT ON THE SMITH MINE EXPLOSION THAT OCCURRED ON FEBRUARY 27, 1943

The Montana Coal & Iron Company having received a detailed report from the Bureau of Mines, Washington, D. C., and the State Industrial Accident Board of Helena, Montana, on the mine explosion that occurred in its Smith Mine at Washoe, Montana on February 27, 1943 in which 74 men lost their lives, hereby explains in detail, its views as to the probable cause of explosion, and comments on certain remarks and statements made in the above-mentioned Federal and State reports.

The Company realizes the extent of the suffering and grief brought about by this disaster, and knowing that an explosion from a similar source can happen at other coal mines, believes that every possible cause of this explosion should be given consideration so that its findings may be of help in preventing the occurrence of disasters at other mines in the future.

The State Coal Mine Inspector is of the opinion that the explosion probably started in the 8th West Main Entry at a point inby the brattice that had been erected across the entry and continued inby to the mouth of room No. 5. The Bureau of Mines' Examiners believe that it probably started in room 5, of the 9th South East. The Company's officials, mine examiners, and foremen are of the opinion that the explosion did not start at the place picked by the Bureau of Mines or the place chosen by the State Coal Mine Inspector.

Before giving the Company's views as to the place where the explosion probably started, we would like to comment on certain happenings, some of which may have played a part in causing the explosion. Other than disagreeing with the State Coal Mine Inspector as to the place where the explosion started, there is little in the State Industrial Accident Board's report that requires comment on the Company's part. We did not notice, however, in the State Inspector's report certain testimony he made at the Inquest held in Red Lodge, Montana, on April 12, 1943. At said Inquest, Mr. Ed Davies testified to the effect that during his many years as State Coal Mine Inspector, **he had never had occasion to stop any employee in the Smith Mine from working in any part of the mine on account of hazardous conditions,** but that on several occasions he has had to stop men from working in other Montana coal mines on account of dangerous working conditions.

After reading the explosion report of the Bureau of Mines made by Messrs. G. O. Arnold, M. C. McCall, and F. J. Bailey, which report was received by the Company on May 25, 1943, we noticed that several important matters were omitted, and sufficient credit was not given the Company for its efforts (notwithstanding a labor shortage due to the War effort) in completing many of the Bureau of Mines recommendations between the time of their mine examination in November and the time of the explosion.

At a meeting in the Company's Washoe office immediately after the completion of the inspection of the Smith Mine by Messrs. G. O. Arnold and M. R. Evans, which meeting was called at the request of Mr. Arnold, the following employees of the Montana Coal & Iron Company were present in addition to the above Federal Inspectors:

J. M. Freeman, Vice President and General Manager
W. A. Romek, Assistant Manager
W. R. Freeman, Mine Superintendent
Elmer Price, Mine Foreman
David Murray, Mine Foreman
Frank Mourich, Inside Master Mechanic
T. H. Freeman, Outside Foreman.

At said meeting Mr. Arnold mentioned that he and Mr. Evans had found traces of methane gas in many of the working places in the Smith mine, and recommended the use of electric cap lamps in place of the open lights that had been in use during the past twenty years or more. Messrs. Arnold and Evans were particularly concerned about the large amount of gas they found in temporarily abandoned entries off the 4th Southeast entry, as some of these abondoned entries contained a larger amount of methane gas than most of the places in other parts of the mine. Mr. Arnold thought that some of these entries, on account of not being worked, should be blocked off as soon as possible, and he suggested that concrete stoppings be built in some of the entries without delay. As the Company expected to work these abandoned entries in the future, Mr. Elmer Price, the Mine Foreman, thought it best to handle the gas in the manner that was in effect during the past year or more. The Federal inspectors, however, thought that it would be dangerous to leave these entries open in case the mine fan stopped from a power failure, as the gas from these entries, under such a condition, could reach the places where the men were working and endanger their lives. As a result of these comments and in order to comply with the wishes of the Federal Examiners the Management issued instructions to the Mine Officials that concrete stoppings be completed as soon as possible in all abandoned entries off the 4th Southeast Entry that were making gas.

The Federal Examiners' comments about the gas in the entries off the 4th Southeast and the gas hazards in other parts of the mine were so convincing that J. M. Freeman, the Vice President and General Manager, concluded that there might be danger and risk to the men's lives if the No. 3 Smith Mine continued operating with open lights and knowing it would take several months to get electric cap lamps because of the war effort, and also realizing it would take a long time (with the labor shortage due to the war) to complete the Bureau's many ventilation recommendations, **suggested that the No. 3 Smith Mine be temporarily closed down.** Mr. Freeman said he could double-shift the Foster Mine, open the old No. 2 Smith Mine, and start the new No. 3 opening east of the mine office, which would soon provide work for the men who would be temporarily laid off. **The Federal Inspectors did not think that conditions in the Smith Mine warranted closing the mine down and said it would also be inadvisable to do this on account of the unusual demand for coal due to the War effort.**

We do not want to give the impression that the Company is blaming the Federal Mine Examiners for suggesting that concrete stoppings be built to wall off gas in abandoned entries in the Smith Mine, as we realize that no one present at the November meeting could foresee that a fall of rock might occur nearby one of the recently-built cement stoppings, on the morning of the explosion, and cave to such an extent that it would release a large quantity of ex-

plosive gas that had accumulated during the three months between the Federal inspection in November and the time of the explosion on February 27, 1943. We estimate that there was space enough in these abandoned entries behind the two concrete stoppings to store about 200,000 cubic feet of methane gas (enough gas to cause one hundred explosions).

Our purpose in bringing up this probable cause of the explosion is that we hope something will come from our views that will help prevent explosions in the future. We are now convinced that it is a very serious matter to block-off old workings in any coal mine where methane is being generated, and sincerely believe that if in the future the Federal Mine Inspectors believe that places making methane gas be blocked-off, they should provide instructions in the erection of stoppings, etc., wherein this gas can quickly escape in large quantities.

As the Management is of the opinion that the explosion resulted from an accumulation of explosive gas behind concrete stoppings, that probably would not have been built had the Smith Mine not been inspected in November, the Company's Foreman and Fire Bosses were requested not to disclose their views to anyone until the State and Federal Examiners reported their final findings as to the source of the explosion. As the Federal and State findings were not reported until after the Inquest, the Company withheld its views at the Inquest, expecting that the final report of the Federal Examiners would change the Management's theory as to where the explosion started. Before receiving instructions not to disclose their views, however, one of the Company's Mine Foremen said he had already mentioned to Federal Inspector Pat Holland that he thought the explosion started from the gas that had accumulated behind the above-mentioned concrete stoppings.

In their report, the Bureau of Mines Representatives go into considerable detail on underground mining methods, conditions, and equipment at the Smith Mine. Before answering their statements, some of which are very misleading, we would like to mention that the Bureau of Mines report on the explosion was prepared mainly by G. O. Arnold, the Federal Inspector, who was in charge of the November examination of the Smith Mine, prior to the explosion, and whose suggestions to the Management might have indirectly had something to do with the explosion, in which case, it was to his interest to unduly criticize the Company.

Coal Dust and Rock-Dusting

The Smith Mine during the past five years was considered to be a damp mine. On page 7 of the Federal Explosion Report, we quote as follows:

"At the time of the inspection in November, the interior of the mine was generally moist, **although dust was apparent throughout.**"

The Management cannot understand why the words "although dust was apparent throughout" were included in the above statement, as Messrs Arnold and Evans, at the November meeting in the Smith Mine office, said that **the Smith Mine was too damp, and the damp air was not good for the men's health.** In their preliminary report, **(the only report received from the Bureau of Mines prior to the explosion)**, they did not mention that they had noticed coal dust in the Smith Mine. They did say, however, that the Smith Mine would become drier when we completed their ventilating recommendations, and that in the future the Company would have to consider rock-dusting. The Management got the

impression from what Messrs. Arnold and Evans said that there was no hurry about rock-dusting the Smith Mine on account of it being too damp. They said that the Bureau of Mines would recommend that all coal mines use rock-dust. In view of the latter statement, we made an effort to locate a source of rock-dust and to secure information on rock-dusting equipment. Based on the manufacturer's promise of delivery, a rock-dusting machine could not have been received by the Company, even if it had been ordered when the Federal Inspectors were here in November. The Federal inspctors did not mention in their report that during the past ten years no Montana Coal Companies rock-dusted their mines.

Permissible Electric Cap Lamps and Gas Conditions at the Smith Mine

Montana coal mines have never used permissible electric cap lamps exclusively to our knowledge. Many of the men in the Smith Mine objected to using them on account of batteries, etc. There were only about one-half of the men using electric lamps at the time of the Federal inspection in November and most of these men worked on loading and haulage crews and were using the electric lamps to prevent delays in output, and not for the purpose of preventing gas explosions, because at that time, the miners, the State Coal Mine Inspector, and the Management did not consider the Smith Mine dangerous. In view of the fact that there had been no explosion during the 35 years it had operated with open lights, and **that only one employee in the Smith Mine, to our knowledge, during the entire length of time had to be treated for gas burns, and this was from his own negligence,** it is no wonder that it is now so difficult to find what caused the explosion. On page 12 of their report, the Federal Examiners mention one other case in the district (about 25 years ago) in the No. 3 bed workings in the old Washoe mine, (operated by the Anaconda Copper Mining Company) five men were burned from gas, but all recovered. The management did not know about this until it was brought to light by the Federal Inspectors. On account of the fact that only one man was treated for burns from gas in the Smith Mine in 35 years, it could hardly be considered very hazardous as far as explosive gas was concerned.

The Management, however, was heartily in accord with the recommendation of the Federal Examiners, that permissible electric cap lamps be used exclusively in the Smith Mine, and sufficient electric lamps for all of the men were ordered as soon as possible and are now on hand. Getting priorities from the Government and delays in securing quotations from manufacturers, etc., slowed up the purchase of these lamps, but on account of Government priorities, etc., the lamps would not have reached the mine prior to the explosion.

At the meeting between the mine officials and the Federal Inspectors, following the Inspection of the Smith Mine in late November, the impossibility of immediately completing all of their recommendations was understood by the Federal Inspectors, due to critical labor shortage and priority restrictions on mining equipment and mine supplies. They agreed, however, that the Company should proceed to the best of its ability, and that one of them would return at a not too distant date to determine what progress had been made. This promised inspection never came about, but a great deal was accomplished by the Company in completing their recommendations between the first of December and the date of the explosion. We list below some of the Federal recommendations that were completed **inside of the Smith Mine prior to the explosion,**

notwithstanding a critical labor shortage. The many Federal recommendations that were completed on the outside of the Smith Mine are not listed. It must be remembered that we had only the Federal preliminary report to follow because the much more lengthy and final report was not completed by Mr. Arnold until after the explosion had occurred, and was not mailed to our Company until March 18th.

Ventilation and Other Federal Recommendations Completed by the Company After the November Federal Examination and Prior to the Explosion.

1. Two concrete stoppings were installed in the 2 East Main and back entries.
2. The size of the air shaft from the No. 2 vein to the No. 3 vein was increased.
3. Rock was removed from the No. 2 overcast and air leaks repaired.
4. Air leaks in all stoppings in the No. 2 haulageway were fixed, also three doors repaired.
5. The door that enters into the airway from the No. 2 slope was repaired.
6. All narrow places in the intake airway were cleaned out by removing dirt and leveling off caves.
7. In the No. 3 vein all of the large stoppings were plastered.
8. At the bottom of the tunnel near the first right entry, a concrete stopping was erected and the door repaired by plastering.
9. An additional stopping was erected in the main south slope outby the overcast, and the pillar broken through inby, which doubled the airway area at that point and generally improved the mine ventilation.
10. All stoppings were repaired and plastered to the first west entry in the No. 3 seam, a distance of approximately 3,000 feet.
11. The fan was moved from the bottom of the shaft in the 2nd north back entry to the back entry of the main South near the 5th Southeast main entry on the inside of the 5th Southeast main door, which very substantially increased the ventilation in the 5th, 6th, and 7th Southeast entries and rooms.
12. An airway was being constructed to the surface at considerable expense and was completed within a few feet of the No. 2 seam. It was located in the first crosscut between No. 9 and No. 10 rooms in the 5th South east entry.
13. Foremen and haulageway men were instructed not to leave ventilation doors open.
14. Mine foremen were instructed to carry safety lamps at all times, and they were examining all places before men entered them.
15. An additional brattice man was employed to improve ventilation in working places.
16. Cleaning was done in both the No. 2 and No. 3 return haulageways.
17. A water tank was installed on the new Sullivan cutting machine so that all cutting equipment in active use carried water for the curtailment of dust.
18. Safety man-holes were provided in the No. 2 slope.
19. A safety bridle was installed to connect the motor with the man trip.
20. Additional mine safety lamps and sufficient electric cap lamps for all employees in the mine were ordered.

21. Canvas bags for carrying powder were ordered and were placed in the mine prior to the explosion.
22. Additional powder boxes, properly locked, were installed throughout the mine, and powder supplies contained therein were reduced.
23. Wooden tamping bars were ordered and sent into the mine, and any metal tamping bars in use were copper tipped in accordance with the State Law.
24. Tamping dirt had been sent into the mine.
25. Permissible powder and electric caps were ordered and received and were being tested by Engineers of the Atlas Powder Company and Du-Pont Powder Company to determine the best grade for our operations.
26. The wooden flooring around the No. 3 hoist was replaced with concrete, and the wooden posts were replaced with structural iron. The rope, hoist gears, and reducer were guarded.
27. All pumps were guarded and defective wiring removed.
28. Other fire hazards in the way of movable material were removed.
29. The mine electricians were instructed to install cut-off switches and to install insulators for carrying feed wire. A part of this work had been completed, but in view of their death, the full details are not available.
30. Transformers in the No. 2 slope were fenced and danger signs installed.
31. Motors on the booster fans were changed from D. C. to A. C. current so that all D. C. power could be cut off when no one was in the mine.

Explosives and Blasting

Shortly after the November Federal inspection, the representatives of both the Atlas Powder Company and the DuPont Powder Company were contacted with respect to making tests to determine the proper grade of permissible powder best adapted to our operations. Orders for 13,900 lbs. of nine different grades of permissible powder were placed, and also requisitions for electric blasting caps. These supplies arrived at the Smith Mine in January, 1943, but as the schedules of the powder company engineers were filled, they did not arrive to conduct permissible tests at the Smith Mine until the two-week period prior to February 27th. In accordance with the Inspector's recommendation, dirt was sent into the mine for stemming, but it did not prove entirely satisfactory for tamping purposes, particularly in wet holes, and in some cases it was mixed with scraping from cross-cut floors, which gave better results. In wet holes the dirt became mud and was useless. Powder storage boxes had been installed throughout the mine, and the quantity of explosives stored in one place had been materially reduced. Canvas bags were ordered and had been taken into the mine shortly before the explosion. Wooden tamping bars had been ordered and were being tried in the mine, but proved too light for tamping pellet powder and resulted in blownout shots. **The metal tamping bars which were used were copper tipped in accordance with the State law.** It is true that pellet powder was still being shot with fuse, but the Federal examiners knew this was only temporary until the proper grade of permissible powder could be determined.

General Safety Conditions

While it is a minor point, the Federal examiners report that only two all-service gas masks were kept in the mine. This is incorrect as we had four such masks. Their preliminary report did not recommend that inside employees be furnished with self-rescuers. The Company has, however, furnished 98 self-rescuers to its employees and has ordered enough for all the men in the mine.

On page 11 of the Federal explosion report under **Supervision and Discipline,** the Federal examiners complain at length to the effect that additional supervisory officials were needed in the Smith Mine. **There was no mention to the management of a lack of supervision by the Federal examiners when they inspected the mine prior to the explosion.** Neither did they mention this in their written preliminary report received by the Company about December 15, 1942. The Management would have gladly, **and immediately,** employed more mine bosses if the Bureau examiners had mentioned that it was advisable, and would have also made any other change in supervision that they would have recommended. The Company had more supervisory officials at the Smith Mine at the time of the explosion than in previous years.

On page 12, they report that when Mr. Newman was placed on the graveyard shift as night foreman, another fire boss was not hired to replace him, which made it appear that the task of extending brattices and keeping all places clear of gas on the day shift, was left to one fire boss. This is not correct, as an extra day-shift brattice man was employed; and at the time of the explosion, the Company had the largest crew of brattice and ventilation employees it ever had. John Meiklejohn, Sanfred Huhtala, Dan Sekulich, and Loren Newman were acting as fire bosses on the three working shifts. Sam Alexander, Ned Laird, and Dick Mallin were day shift brattice men and were assisted by John Meiklejohn when his fire boss duties permitted. Sekulich and Huhtala also did brattice work on the night shift in addition to inspecting the mine. In addition we tried to employ Leland Newman, the only other experienced fire boss in this district, but without success.

On page 14, the Federal examiners report that according to testimony at the Inquest the haulagemen continued to leave doors open across haulageways and leave brattice curtains up at room entrances. According to our recollection, **the preponderance of the testimony at the Inquest** was exactly opposite to that statement. All haulagemen had been instructed by the Management to adhere to the State law, as the law makes it the employee's duty to keep ventilation doors closed, and any known violations would not have been tolerated by the Company. We quote from Montana Statute 3527:

"Motormen, trip riders, and drivers in charge of hauling trips, passing through doors used as a means of directing the ventilation, shall see that such doors are closed promptly after the trip passes through."

As for the continuation of smoking in the mine, a practice that has always been in effect in all Montana coal mines, it was not reasonable to expect the men not to smoke as long as they had to use open lights, due to the fact that electric cap lamps were not available. Extra precautions were taken with regard to testing for gas before employees were permitted to enter for work. All bosses carried safety lamps; and in addition to the fire bosses' inspections, they examined every working place before the men entered, which was not the case previous to the Federal inspection. No matter how busy or how rushed the mine foremen were, all places were tested before employees entered them, **and no evidence to the contrary was ever persented.** As for the air reaching the 5th, 6th, and 7th South East entries, the preponderance of the testimony at the Inquest was that the air had been substantially improved following the November examination.

On page 15 of their report, they state that much dust was made during the cutting of coal. The two Sullivan cutting machines, **which did all our cutting**

in the No. 3 seam were equipped with water tanks and water was applied to both cutter bars. The Jeffrey cutting machine was taken to the No. 2 seam, and was operated very infrequently in working places that were wet.

Item 4 on page 17 deals with the practice of "nipping." The shortage of trailing cable due to the War is known to every mine operator, and our Company was ordering cable to the full extent permitted by its quotas. The quantities we asked for were drastically reduced by the War Production Board. To indicate this shortage we cite on August 26, 1942, we ordered 1,400 feet of trailing cable, and gave the highest ratings permitted by the War Production Board. Notwithstanding these high ratings, only four hundred feet were received prior to the explosion.

The statement on page 17 of their report that there was very little cooperation between employees and Management in connection with the establishment and enforcement of safety practices is incorrect. Every United Mine Worker who testified at the Inquest testified that there **was** cooperation, and the only exception mentioned to the Management was the difficulty of preventing the men from jumping off the man trip before it stopped.

The Federal report, in our opinion, places Dave Murray, Mine Foreman, and John Meiklejohn, Fire Boss, in an unfavorable light, by intimating that it was their negligence in not examining Room 5 of the 9th South East entry on the morning of the explosion that indirectly probably caused the explosion. The Company can prove that the explosion did not start in Room 5 of the 9th Southeast panel and that neither Mr. Murray or Mr. Meiklejohn were negligent in their duties on the morning of the explosion. No evidence or testimony has ever been presented or brought to the attention of the Management that either of these men was ever careless or negligent while on duty. In support of our contention that they had no part in causing this explosion, we wish to say that Federal Bureau examiner, M. C. McCall, when he and other Federal examiners went into the 9th South East entry during the rescue effort and after they stopped in the slant and looked at the post on which the slant door hung prior to the explosion, made the remark, **after noticing that the angle irons that supported the door were bent inwards toward the face of the 9th South East entry, "that leaves out the mine foreman with the safety lamp at the mouth of Room 6."** The mine foreman referred to in this remark was Dave Murray. This remark of Mr. McCall's is very good evidence that the explosion could not have started in Room 5 of the 9th South East panel, where the Bureau examiners are trying to establish the source of the explosion.

It is quite evident from the above comments that the Federal examiners didn't give the Company much credit for its unusual effort, **under abnormal war conditions,** in completing so many of their recommendations, and trying so hard to get electric cap lamps, permissible powder, and rock-dusting equipment.

Why the Explosion Could Not Have Originated in Room No. 5, off the 9th Southeast Panel, THE PLACE PICKED BY THE FEDERAL EXAMINERS AS THE PROBABLE SOURCE.

Initial Force of the Explosion

The initial force of the explosion was inby and opposite to what it would be if it started in the 9th Southeast panel for the following reasons:

1. The transit box and tripod that were in the supply room off the machinery repair shop located North of the 9th Southeast panel and near the 7th Southeast panel, were blown down hill (South) or inby from the Northeast side of the supply room in a direction towards the East Main South Back entry, indicating that the initial force came down all three of the Main South entries. The transit box and tripod were blown against one of the posts located in the center of the supply room, which post supported the shelves back to back. The initial force came in from the Main South entry and destroyed these shelves, one of which contained boxes filled with welding rods, which boxes fell on the tripod and transit and crushed them. Six feet of a row of shelves in the shop were blown inby from the Main South entry in a Southerly direction to the East Main South Back entry.

2. Most of the sand boxes, which usually contain about two tons of sand for haulage purposes and which were located in several places on the Main South entries, definitely indicates that the initial force of the explosion was inby and came from the North, as these sand boxes were moved down the hill towards the 9th Southeast panel in a Southerly direction.

3. Three loaded mine cars on the main parting, located in the 1st West entry, at the North end of the active working places in the Smith Mine and near the 4th Southeast entry, near which entry the Company thinks the explosion started, were blown on their side against the **South** rib of the parting, **which is definite evidence** that the initial force that upset these loaded cars, which weighed more than five tons each, was terrific and definitely inby and came from the North and not from the South as the Federal examiners are trying to establish.

4. Six cars of props in the slant between the Main South entry and the East Main South Back entry, which is part of the 9th Southeast Back entry, and near the place picked by the Federal inspectors, were blown with such an **inby** force, which force came from the North, that the West end car was jammed against the rib of the 9th Southeast Back entry and the props in this car were moved out of the car in an **inby** direction, a distance of three feet. If the explosion had started in this 9th Southeast panel, as they think, the initial explosion certainly would have blown these cars against the opposite rib as the force of the explosion was particularly terrific in this section of the Mine.

5. In a slant in the 9th Southeast panel, picked by the Federal men, the initial force was **definitely inby** and opposite to what they claim it was because on the post on which the slant door formerly hung, **the initial force of the explosion bent the angle irons inwards toward the face of the 9th Southeast entry.** These angle irons would have been bent in the opposite direction had the explosion started in Room 5 in this entry.

Comments on the Federal Examiners' Theory

On page 27 of the Bureau's report under "Probable Causes of the Explosion," we quote from their report as follows:

> "According to various information received, the line brattice was extended to within 70 to 100 feet of the face. The place was drilled and shot about 10:30 p. m. the night before the explosion. Gas was recorded as found in the place February 20, 21, 22, 23, 24 and 25. The man who acted as fire boss on the night shift (up to midnight) on February 26 stated to the investigators that he found gas in the place that night, before the face

was drilled and blasted. For some reason, a record was not made of gas being found in the place on February 26. On the morning of the explosion, the fire boss who was killed examined this panel, and there is no record of his findings."

The Company challenges the Federal inspectors to prove the statement "the line brattice was extended to within 70 to 100 feet of the face of Room 5" (where they think the explosion started). Sanfred Huhtala, the man who acted as fire boss on the night shift on February 26th, the night previous to the explosion, and referred to in the above statement, says he made the following statements to Mr. Arnold in the presence of Federal Inspector F. J. Bailey, and Mr. Loren Newman, a Company foreman:

Sanfred Huhtala said he told Mr. Arnold he inspected the 9th Southeast entry on the night of February 26th, **the night previous to the explosion,** that his inspection started about 4:30 p. m. and that he examined all of the rooms and the Main and Back entries in the 9th Southeast panel. He said he also told Mr. Arnold in the presence of the above men that he discovered only a trace of gas (less than 5 cubic feet) in Room 5 and reported it to Mr. Martin Rapp, the mine foreman, who instructed him to install a line brattice at once to remove this gas. Mr. Huhtala says he also told Mr. Arnold that a line brattice was built as soon as possible **to within 18 feet of the face,** (not 70 to 100 feet mentioned in the Federal report), and the line brattice was completed at once. Mr. Huhtala says he further told Mr. Arnold that he and Mr. Rapp inspected Room No. 5 shortly after the line brattice was completed **and could not find a trace of gas in their examination of this room on the night before the explosion.**

During the questioning of Mr. Huhtala as to the above, he told the Management that shortly after the explosion, with the above line brattice destroyed by the force of the explosion, and normal ventilation destroyed which resulted in less than one-half the air circulating in No. 5 room than was in this place prior to the explosion, that he found less than ten cubic feet of gas in Room No. 5. He also said that several weeks after the explosion, and after the line brattice had been rebuilt, and notwithstanding that there was less than one-half the normal ventilation in the Smith Mine at that time, Room No. 5 was clear and free from explosive gas.

Considering that the Federal examiners during their thorough examination in November never reported to the Management that they found **even one active working place in the Smith Mine** where there was enough gas to even burn a man, let alone cause an explosion, and also considering the above statements by Mr. Huhtala, which Mr. Arnold should know to be the facts, it is difficult for the Management to understand the Federal examiners' explanations as to the probable cause of the explosion.

In further proof that the explosion did not start in Room 5 we mention the following:

The fireboss's date for February 27, showing he inspected Room 5 on the morning of the explosion, is on the roof at the face of No. 5 room in the 9th Southeast panel, which is evidence that there was not a large amount of gas in the place **when he examined it about six o'clock on that morning.** Also there is evidence that the trackman had worked in Room 5 for over an hour that morning, as he had broken the track and cleaned it out to make room to lay a

switch. He had taken the materials into the place, and had worked at least thirty feet inby the point at which he was working when the explosion took place. It is difficult to see how he could have moved about the room doing that work for over an hour before lighting the gas. Also, if he had ignited the gas, he would have been blown toward the entry and not toward the face of the room as the gas would have been between where he was working and the face. The foreman, while making his rounds, always visited the places where men were working, and it doesn't seem reasonable that he would have walked by the place where men were preparing to lay a switch and go to a place where there was no one working to test for gas. The evidence shows that the foreman was preparing to test for gas in Room 6 at the time of the explosion.

Under the Federal representatives' theory, it is difficult to understand how so little gas, if there was any, (as the Company claims Room 5 was absolutely free from explosive gas on the morning of the explosion) could develop enough force in such a short distance to move a sand box **down hill** on the Main South entry in the next entry below the 9th Southeast panel, and turn on an angle of about 135 degrees to do this. The explosion force would also have to reverse its course in the 8th Southeast entry, just a short distance from Room 5 and develop enough force to derail a 20-ton mine locomotive and move a fan a distance of 285 feet in the 8th Southeast entry (the next entry immediately above the 9th Southeast panel **and a very short distance away**). It is not reasonable to assume that enough coal dust in a comparatively damp mine like the Smith Mine, or even a dry mine, could add to the force of the explosion to such an extent, and do such damage **in a reverse direction,** in such a short distance.

The Company's Views on the Probable Cause of the Explosion

On account of the comparative dampness of most of the entries in the Smith Mine, prior to the explosion, the Management has always been of the opinion that **it required the ignition of an unusually large amount of methane gas** to disturb the comparatively damp coal-dust into suspension, so that it would add to the fury of the explosion. No quantity of gas in the amount even **large enough to burn a man was ever reported in any of the places where men were working in the Smith Mine by the Federal examiners** during their lengthy inspection, which is substantiated in their preliminary report.

In view of this and the fact that only one man was severly burned in 35 years in the Smith Mine by gas, and as this was in a place that was not being actively worked, and **considering the above evidence,** it would seem impossible that enough gas could accumulate **between shifts** in room 5 or any other active working places in sufficient quantity to start an explosion of this magnitude.

The only place near where the men were working in the Smith Mine where a large quantity of methane gas could accumulate was in the abandoned 2nd East Main and Back entries, which entries were blocked off by cement stoppings in accordance with an understanding with the Federal inspectors at a meeting held in the Washoe office in November. The building of these stoppings permitted a three-months' accumulation of gas, and as these abandoned entries were generating more methane than the entries where the men were working, it is not unreasonable to assume that an extremely large amount of gas accumulated behind these stoppings between the time the Federal inspectors

examined the mine in November and the time of the explosion. The air or gas area behind these stoppings was about 200,000 cubic feet.

Regarding the drying of the mine and the coal-dust hazard, it is to be expected that the mine did dry out to a certain extent during January and February from the improved ventilation resulting from the completion of the ventilation recommendations suggested by the Federal inspectors. As an example of this better ventilation, we refer to the preliminary report of the Federal examiners wherein they state the West panel entries were well ventilated, but the air in the East panel entries (which is on the last of the air current) should be increased. The last reading obtained by the Federal inspectors in November in the 2nd Southeast panel entries was only 10,000 cubic feet. The last air-reading of record taken in the same last cross-cut by Mr. Elmer Price, mine foreman, on February 23rd (four days prior to the explosion) shows the reading to have been 20,000 cubic feet, which indicates that the air volume **was doubled** in this part of the mine just prior to the explosion. This improvement in ventilation, no doubt, did help dry out certain parts of the mine and make the coal-dust easier to explode.

The Company's theory as to the probable cause of the explosion is as follows:

Up until the time the concrete stoppings were constructed in the 2nd East Main and Back entries off the 4th Southeast, methane gases produced in these entries **were safely controlled through direct ventilation.** However, through the sealing up of this section, a vast storage reservoir was created, which each day added to its capacity by the pressure of the incoming gases. Examination of these concrete stoppings after the explosion plainly shows that a cave had occurred **prior to the explosion,** directly over the cement stopping in the back entry, leaving an opening approximately 2 feet high by the width of the entry (about 12 feet wide), providing a large opening for the pentup gases to escape quickly and in large volume into the return airway, a short distance from the air shaft leading up to the No. 2 seam and old No. 2 workings. These gases, released by the cave over the cement stopping and, no doubt, under pressure, united with the return air, creating a very highly explosive mixture. The air shaft from the No. 2 seam contained a 3-phase high-voltage transmission line with fuse terminals at the bottom of the shaft. Examination of these fuses, after the explosion, showed that one of the phases had blown a fuse. The heavy load carried by this transmission line, sufficient to blow a fuse, would create quite a flash or arc, making this the most probable source of ignition. Ignition of the gases at this point worked both inby and outby. Forces from this initial explosion working inby, blew the main entry cement stopping completely in, and also blew in **the exposed part of the back entry cement stopping that was not protected by the cave.** The fact that the cave in the back entry protected most of the cement stopping from moving in either direction, is proof that the fall of rock that released the gases fell immediately before the explosion started. The increased size of the back entry opening, as the result of the top part of the cement stopping having blown down, permitted more of the pentup gases to escape. Ignition of this additional large volume of gas created forces that were strong enough to stir up even damp coal-dust and develop a major explosion. All the above is plainly indicated by the telltale trail of the major forces. Major forces working from the probable point of ignition at the bottom of the air shaft, near the pentup gases, rushed down the No. 1 room of the 1st West entry, upsetting three loaded cars on the main parting, and pushing them

against the lower (South) rib, definitely proving that the major force traveled from the above-mentioned point of ignition in a Southerly direction which direction is opposite to what it would have been had the explosion originated in the 9th Southeast panel, the place picked by the Federal examiners. The forces then went down the main South entry, destroying the switching gear at the Rotary-Converter stations and destroying the machine repair shop, and probably stirred up a great amount of coal-dust, which permitted the explosion to gain in intensity as it travelled inby to and beyond the 9th Southeast panel, where the Federal examiners think it started. The enclosed map, prepared by the Company, will explain the source of the explosion in more detail.

Lessons to be Learned from This Explosion

On page 30 of their report, the Bureau of Mines examiners, under the above heading, try to leave the impression that the Company is the only party that should learn a lesson from this terrible disaster. We **certainly** do not agree with this conclusion. Whether or not the Company's choice of the origin of this explosion has any merit, and we sincerely believe it has, and is more sound than any theory yet submitted, it would be a terrible mistake, **for the sake of saving of lives in the future,** if the Bureau of Mines did not impress upon its coal mine examiners to do the following things in their examination of coal mines in the future:

1. That before suggesting that coal companies block-off places that can accumulate considerable quantities of explosive gas, the Federal examiners should take into account, that falls of rock and squeezes might release this gas quickly in dangerous amounts and cause an explosion, and they should also recommend to the coal operators that double concrete stoppings and other precautions be taken to prevent this extremely dangerous source of explosions from causing disasters in the future, **especially in mines where they know that open lights, trolley mine locomotives and non-permissible electric equipment are being used,** as was the case at the Smith Mine.

2. That Federal mine examiners should be very careful in suggesting to coal operators that ventilation improvements be made, that will have a tendency to dry out a mine and increase a coal-dust hazard, before rock-dusting equipment can be made available, **especially in mines where open lights and non-permissible electrical equipment are used,** or cannot be procured for an indefinite length of time, as was the case at the Smith Mine.

Summary

The Company would like to mention that it believes the above comments prove that since the Federal inspection in November, it did everything within reason, under war condition, to avoid accidents. In November, when the Federal representatives were at the Smith Mine, the Company offered to close down this mine at considerable loss in revenue, rather than place its employees in a position where their lives might be endangered.

The Federal examiners convinced the Management that the Smith Mine was not dangerous, **even though it was absolutely necessary to use open lights in the mine,** as the Bureau representatives knew that electric cap lamps, because of the war effort, **could not be purchased by the Company for several months.** In support of our contention that the Federal men thought the Smith Mine safe, we wish to state that at a public meeting in March, 1943, held at the mining town of Bear-creek, where the Smith Mine is located, and in answer to a question as to

whether he considered the Smith Mine a dangerous mine when he inspected it in November, we understand Mr. Arnold stated that **he did not consider the mine dangerous,** and if he had, it would have been his duty to notify the State Coal Mine Inspector to that effect.

The State Coal Mine Inspector thoroughly examined the Smith Mine on January 27, 1943, **only one month prior to the explosion,** and the State Industrial Accident Board of Helena issued a Certificate of Inspection, approving of the condition in the Smith Mine as of that date.

Notwithstanding a very strenuous effort (which was to be expected as the result of such a terrible disaster) there was no testimony at the Red Lodge Inquest that indicated **that the Company did anything in operating the Smith Mine that was contrary to the State mining laws of Montana,** or did anything in the operation of the Smith Mine that was radically different from what was being done in all Montana coal mines.

In conclusion, the Company wishes to say that the two things, **that it cincerely believes contributed more than anything else to causing this explosion,** viz., **the accumulation of methane gas over a three-month period in temporarily abandoned workings,** by the building of cement stoppings that apparently would not have been built immediately after the inspection were it not for the November Federal examination, **and the drying out of the coal dust in the mine** to a certain extent on account of improved ventilation resulting from completing certain recommendations of the Bureau of Mines, **were things that the Company was not directly responsible for.**

In further support of our contention that there was not enough gas **in any of the active working places in the Smith Mine on the morning of the explosion to even burn a man, particularly in Room No. 5 in the 9th Southeast panel** (where the Federal men think the explosion started) we want to mention that notwithstanding the Smith Mine has been closed down for three months and the only work done in the mine is the repairing of stoppings that were destroyed by the explosion and the removal of machinery, equipment, and mine tracks, and that there is only about one-half of the volume of air in the mine that there was on the morning of the explosion, **there is still not enough gas in any of the said active working places to cause an explosion.** The Fire Bosses report that since they replaced the line brattice, in the above-mentioned Room No. 5, that was blown out by the explosion, that this room has been entirely free of gas during the past three months, **which proves that this room certainly must have been free of gas on the morning of the explosion** and the disaster could not have started in this room where the Federal Examiners think it originated. This room can be examined by anyone who wishes to do so at this time.

The Company, however, does not blame anyone for the disaster, as it realizes that the fall of rock that permitted this accumulation of gas to quickly escape was not predicted by anyone present at the November meeting. The Company also realizes that neither the Federal examiners nor the Company mine officials anticipated that the Smith Mine would dry out to such an extent in the short time between the November inspection and the time of the explosion.

The Company believes the Federal examiners were very unfair in their report on the explosion in withholding essential facts and making many misleading statements. Notwithstanding the Management agreed to close the No. 3 work-

ings if the Federal inspectors thought there was danger of anyone losing his life, and also notwithstanding the inspectors **agreed in November to the use of open lights in the Smith Mine** until electric cap lamps could be procured. **which they knew would take months on account of the war effort,** they blame the Company for using open lights (which they themselves permitted) and try to prove that the explosion started from an open light in a place where the mine foreman and fire boss might be proven negligent.

In no sense of the word, are the foregoing comments intended to reflect in any way upon the United States Bureau of Mines or its efforts to save lives, which efforts, the Company is heartily in accord with and desires to cooperate with to the fullest extent.

We cannot speak too highly of the speed with which the Bureau of Mines men and equipment arrived at the Smith Mine for the rescue effort. The quality of leadership displayed by the Representatives of the Bureau, and the **individual courage and self-sacrifice of each one, are praiseworthy to the extreme.** The Company is grateful for their help in this disaster and feels greatly indebted to every Representative of the Bureau of Mines who assisted in the rescue effort.

Respectfully submitted,

MONTANA COAL & IRON COMPANY,

J. M. FREEMAN, Vice President and General Manager.

W. A. ROMEK, Assistant Manager.

MONTANA COAL & IRON COMPANY

ACTIVE SECTION NO. 3 VEIN

WASHOE JUNE 10 1943 MONTANA

LEGEND

DOUBLE BOARD STOPPINGS
DOORS
MINE CARS
LOCOMOTIVES
LIBERATED GASSES
INITIAL FORCE

100 200 400

Second Left

AIR SHAFT to No. 2 Bed where explosion probably started

Three wire high voltage transmission line and Fuse terminal at bottom of air shaft, one fuse was blown making this possible source of explosion

Cave over Seal released gas into return air circuit creating an explosive mixture

Cave that occured prior to explosion releasing gasses penned up by seals

Section of seal blown in by explosion

Normal roof line

Path of escaping gas

12" Concrete seal

CROSS SECTION GAS SEAL & CAVE

where aprox 200,000 cubic feet of methane gas accumulated

12" Concrete Seals

Storage capacity back of concrete seals aprox 200,000 cubic feet

3 Loaded cars turned on side from inby force

No 3 Booster Fan

3 S E.

1 W

2 W

2 E

1 E

R C Stations

1 W

6 S E

Shop

4 W

7 S E

Pump

5 W

Pump

Rotary Converter Stations

8 S E.

6 W

2C Ton Locomotive blown off track from inby force

No 2 Booster Fan

Core of props blown ogothat south rib from inby force

9 S E.

Pump

7 W

Sand Box

10 S E.

8 W

Where Federal Mine Examiners believe explosion probably started

Sand Box

11 S E.

9 W

Line brattice installed right before explosion to within aprox. 18 feet from face making it impossible for any gas to accumulate in room 5

Note..
In order to avoid confusion, Initial Inby—Force and direction of Liberated Gasses is all that is shown on map

-SOUTH-

Edw. F. Conlo 61243

REPORT OF MINE EXPLOSION

Smith Mine, Montana Coal & Iron Company

Washoe, Carbon County, Montana

February 27, 1943

Prepared by

W. A. BOYLE, President

JOE YANCHISIN, Board Member, Subdistrict No. 3

JOE MASINI, International Board Member

Representing District No. 27

UNITED MINE WORKERS OF AMERICA

Billings, Montana

Mr. John L. Lewis, President,
United Mine Workers of America

My Dear Mr. Lewis:

The worst coal mine disaster in the history of Montana occurred about 9:30 a. m., February 27, 1943, in the Smith Mine of the Montana Coal and Iron Company at Washoe, Montana. We, the undersigned representatives of the United Mine Workers of America, as members of the investigation committee of the explosion, in which 72 members of our organization and 2 mine officials lost their lives, herewith submit to you our report and findings.

Smoke pouring from the mine entrance about 10 o'clock that morning, was the first indication of trouble. Alec Hawthorne, hoisting engineer, called the surface and said, "There's something wrong down here. I'm getting out." he was rescued alive with two others. Two bodies and the three injured men were carried from No. 2 vein which had been used only as the haulageway. The 72 other trapped men were in No. 3 vein.

Ed Davies, State Coal Mine Inspector, arrived at the mine shortly after the accident and immediately entered the mine to direct the working of the rescue crews.

Smith Mine employees worked throughout the day repairing stoppings which were damaged, while a rescue squad was flown to Billings from Butte, equipped with masks. Experienced coal miners from Musselshell and Cascade counties, and chrome miners from Benbow and Mouat mines, aided the rescue squads made up of local men.

The rescue crews worked in six-hour shifts, under the supervision of the United State Bureau of Mines officials. We recognize that the Federal Inspectors with their years of experience in the coal mining industry, the technical knowledge they have acquired through years of study, along with the efficient manner in which they directed the rescue operations, was of great value during the time of the disaster. We wish to acknowledge and highly commend the assistance and services of Mr. D. F. McElhatton of the Mines Safety Appliance Company, his knowledge in the use of mine safety appliances and suggestions offered by him during the rescue operations was also valuable.

The crews penetrated deeper into the mine workings as stoppings were repaired and fresh air circulated. The installation of the exhaust fan in the old Foster mine openings aided in withdrawing of the poisonous gasses. As the rescue squads worked their way into the mine openings they began discovering the bodies, which they wrapped in canvas and carried them to the First West rope parting to await removal to the outside.

The first bodies to be removed from the First West parting were 32 in number, taken to the outside the night of March 4th. On the nights of March 5, 6, and 7, there were 15, 23, and 2 bodies respectively removed to the outside. The signers of this report were present at the removal of all the bodies.

Death notes written in chalk on rough boards by five of the victims, not found until the seventh day, told their own story of how the men calmly awaited the poisonous gas they knew would come. The messages were found near the inby end of 5 Southeast panel.

Front and Back of One Board

Front

"It is five minutes past 11 o'clock
Dear Agnes and children, I am sorry
we had to go this way. God bless you
all. Emil, with lots of kisses."

Back

"Frank Pinich
John Sudar
and Joki
We tried our best but could not get out."

Second Board

"Walter & Johnny Good-bye
Wives and daughters. We died an
easy death. Love from us both.
Be good."

These men made a futile attempt to barricade themselves from the noxious gasses.

Words cannot express the gratitude of the United Mine Workers to the Local Women and the Red Cross for the service they rendered throughout the sorrowing community, and at the mine during the recovery operations. The Red Cross set up an emergency hospital which was used principally to revive rescue squads who were overcome by the noxious fumes in the mine. The Local Women and the Red Cross in caring for the rescue workers and the bereaved families, served hot food continuously at the mine. Wives, children and relatives stood at the mine entrance for days refusing to give up hope; standing mutely by, or praying audibly that their loved ones would be brought to the surface alive.

The Anaconda Copper Mining Company of Butte, and the same company operating the Defense Chrome Account Mines at Benbow and Mouat, along with the other companies throughout the state, are to be commended for making it possible that the employees and rescue equipment could be available at the time most needed

The Montana Highway Patrol should be praised for the services they performed in the transporting of the rescue workers to and from the mines during the terrible winter weather that we had at the time of the disaster.

Governor Sam C. Ford visited the scene of the disaster and offered any State assistance in the emergency. In his special message to the Legislature, which was still in session, he asked that an investigation fund be allowed for an inquiry by the State into this disaster. The Montana Legislature passed a bill appropriating $5,000.00 for a thorough examination into the cause of the Smith

Mine Disaster. Governor Ford's investigating committee is now at work investigating the explosion. On behalf of District 27, United Mine Workers of America, we extend our sincere thanks to his Excellency.

To Mr. R. V. Bottomley, Attorney General, we offer our thanks and appreciation in the lending of his able assistant, Mr. George S. Smith, to the County of Carbon to assist in the investigation held over the bodies of those men killed in the explosion.

District 27, United Mine Workers of America, takes this opportunity to express our gratitude to Mr. J. Burke Clements, Chairman of the Industrial Accident Board, for his assistance, and prompt work in preparing the claims of the sorrowing dependents.

We wish to make mention of the fine work done by Mr. Barclay Craighead, Chairman of the Unemployment Compensation Commission in his handling the matter of unemployment claims of those who survived the disaster at the Smith Mine. To Mr. Craighead we also offer our thanks.

The Smith Coal Mine comes under the jurisdiction of Local Union No. 858, United Mine Workers of America, and the writers of this report attended the first meeting held after the explosion and disaster that rocked this community. It was a sad meeting for anyone to attend. President Lewis's message of condolence was read at this meeting, along with an explanation that the International Union had arranged for a cash contribution of $7,400.00 to be placed at the disposal of District President Boyle, to be distributed among the dependents of the 72 members of the United Mine Worker and those dependents of the 2 bosses who were also the victims.

The investigation of the explosion, in an attempt to determine its cause, began on Monday, March 22nd, and continued throughout the week; conducted by Federal Bureau of Mines Inspectors, Messrs. Arnold and Bailey, and State Mine Inspectors Davies and Henry, the Smith Mine Company Officials, Messrs. Romek, Newman and Freeman.

We wish to make it clear that we do not pretend to possess the technical mining knowledge of the Federal and State inspectors. We have studied their reports and the report of the Company officials and we find that they disagree as to the point of origin of the explosion, and the direction that the explosive forces traveled. All agree that the explosion was caused by the ignition of an explosive mixture and that dust propagated it from the point of origin throughout the rest of the mine.

Our study of the reports and examination of the mine has led us to the conclusion that we cannot accept the findings of the Federal Inspectors and those of the Company oficials as to the point of origin of the explosion.

The Company officials selected the 2nd East off the 4th Southeast, as the starting point of a sequence of events that led up to the explosion. They declare that concrete stoppings were erected in the main and back entries, one in each entry, at the insistence of the Federal Inspectors who inspected the mine during the latter part of November, 1942. The stoppings sealed off old workings that generated small quantities of gas, and the area sealed off is estimated as sufficient to contain 200,000 cubic feet of gas.

The Company assumes that a cave occurred directly over the concrete stopping in the back entry. The cave released the explosive gas which entered the return air current and traveled to the upcast shaft that connects the No. 3 and the No. 2 veins in the mine. The gas was set off by the blowing of a fuse in the high power line at the bottom of the shaft. From that point, the explosive force traveled back to the concrete stoppings and blew them towards the faces of the entries. They declare that only the exposed part of the stopping in the back entry, where the cave occurred, was disturbed by the force of the explosion. The rest of the stopping was protected by the cave, and judging by a sketch of the same on a map prepared by the company in support of their contention, remained intact.

The difficulty in accepting the Company's conclusions is that two miracles were necessary in order to bring about the sequence of events which they believe led to the explosion. The cave over the stopping in the back entry which they declare took place could not have happened. A roof that is supported in any manner, by props, cross bars, or even concrete stoppings, cannot fall unless the supporting medium gives way on account of the pressure exerted upon it. There is but one departure from this rule, and it occurrs when the prop, or cross bar or other support, remains intact and the nature of the roof is such that it gradually crumbles. Examples of this particular kind of roof can be found in almost every mine. They can be found in the Smith mine in an entry adjoining the 2nd East.

If we accept the Company's conclusion in regard to the cave, then we must believe that a concrete wall one foot wide and about eight feet in height and twelve feet in length could not support two feet of over-burden, a part of which was coal; and that the roof fell but the concrete stopping was undamaged, and remained intact until the force of the explosion that traveled from the upcast shaft blew the exposed portion towards the face of the entry. We must disregard the fact that the door in the slant off the 2nd East entry was blown inby, and this could not have happened if the original explosive force had traveled from the shaft inby to the 2nd East entries.

The other miracle was the blowing of the fuse at the shaft at practically the same time that the cave over the concrete stopping occurred. If this were not a miracle, it could be described as a most remarkable coincidence.

We do not know which of the Company's investigators formulated this theory as to the point of origin of the explosion, but it was not mentioned by any of them while the investigation was in progress. We were assured by the management at the time our investigation was being conducted that the mine officials had been instructed to keep nothing that they knew, or that they had discovered, from the Federal and State investigators. Now, we find the statement in the Company's report to the effect that their officials had been instructed not to make known to anyone their findings in regard to the cave that released the gas in the 2nd East entry, and the blowing of the fuse at the air shaft.

We are of the opinion that if such an extraordinary cave had occurred, the Company officials would have brought it immediately to the attention of the other investigators, and the necessity of straining their imaginations would have been avoided. As the result of their failure to cooperate with the other investigators they cannot now produce their number one exhibit in support of their theories. The evidence has been covered by bigger caves at the point where

the concrete stopping stood in the entry, as the result of the destruction of the stopping.

We have found from our experience that investigators usually emphasize, stress, and point out every factor that in any degree supports their theories. We are now informed that such was not the case with the Company's investigators. Yet, strange to say, we are now asked to accept their findings without any corroborative evidence from any of the other investigators.

All the investigators, while investigating, were in agreement in regard to the impossibility of explaining the conflicting evidence as to the paths that the explosive forces traveled throughout the mine.

This problem presented no difficulties to the Company's officials when they made their map. A glance at their map of the mine with red arrows indicating the initial direction of the explosive forces justifies this statement. A note on the map states "that in order to avoid confusion, initial inby force and direction of liberated gases is all that is shown on the map." We know that the direction of the initial force of the explosion as indicated on their map, cannot be followed as easily as the red arrows make it appear.

To the layman, the Company may appear to have made out a strong case in support of their contention as to the point of origin of the explosion and the events that led up to it. However, any mining man of experience will readily agree that the case they have made out is based upon an impossibility, namely, that a concrete wall of the dimensions stated could not support an over-burden of two feet, and that when the cave occurred the concrete stopping was intact and undamaged.

We submit that it is far more reasonable to assume that the cave occurred after the concrete stopping was destroyed by the explosive forces, than to assume that a cave occurred directly over the stopping while the stopping remained undamaged and intact.

The State Mine Inspectors' report covers the entire mine and is based on the evidence which they discovered, and they reached the conclusion that the point of origin of the explosion was near the face of the 8th West Main entry.

The Federal Mine Inspectors Report has this to say of the report made by the State Inspector:

> "All of the above facts are substantiated by evidence in the panel. The reasoning is good, but the only difficulty in selecting the solution is that of reconciling this solution with the definite path of propogation as described in the discussion of the 9 S. E. panel."

The above quoted statement of the Federal Mine Inspectors' report leads to the conclusion that the point of origin of the explosion was in the 8th West main entry as assumed by the State Inspectors. Our reason for so concluding, is that the definite path of the initial force of the explosion in the 9 S. E. panel entries traveled from the mouth of the main entry towards the face.

In helping us to arrive at our conclusions as to the point of origin as stated, we have carefully studied the Federal Inspectors report, the Company

Official report, and the report of the State Inspectors. The report of the State Inspectors appears to us to be a plain statement of the conditions that they found; and we are in agreement with the statement contained in the Federal Mine Inspectors' report that all of the facts that they mentioned in regard to the 8th West **"are substantiated by evidence in the panel."**

The Executive Officers of District 27, United Mine Workers of America, requested a joint meeting with the Montana Coal Operators Association. The meeting convened on December 22, 1942, for the purpose of discussing proposed legislation, and those recommendations already made by the Federal Mine Inspectors in their preliminary report of the Smith Coal Mine. The Officers of the District organization requested that the Coal Operators lend a cooperative hand at the coming session of the Legislature, convening the first week in January, 1943, to the end that at least the major recommendations made by the Federal Mine Inspectors would become part of the Montana statutes. All of the efforts on the part of the Coal Miners at this meeting met with failure, and the meeting adjourned without the miners receiving the necessary cooperation in order that the recommendations be embodied in the Montana Laws. Therefore, we, the signers of this report, feel that had those major recommendations made by the Federal Inspectors been incorporated in the Montana Coal Mining Laws of the last session of the Legislature, January, 1943, and had they been enforced, that in all probability we never would have experienced an explosion of this magnitude in the coal mines of this state.

We are of the opinion that the only sure prevention against another such disaster in our mines, is the amending or rewriting of the Montana State Coal Mining Code, and embodying therein those recommendations made by the Federal Mine Inspectors, those that may be recommended by the Governor's Commission, and also those of the Coroner's Jury verdict that we are submitting herewith:

VERDICT OF JURY

STATE OF MONTANA)
) ss.
COUNTY OF CARBON)

An inquisition taken at Red Lodge in the County of Carbon, on the 12th, 13th and 14th of April, A. D. 1943, before Edward Olcott, Jr., Coroner of the said County of Carbon, upon view of the bodies named on the attached list, lying there dead, by the oaths of the Jurors whose names are hereto subscribed, who, being sworn to inquire, on behalf of the State of Montana when, how, and by what means, the said persons came to their deaths, upon their oaths do say:

That on February 27th, 1943, at the coal mine of the Montana Coal & Iron Company located at Washoe, Montana, met their deaths due to concussion and to gas poisoning caused by gas and dust explosion.

As a part of this verdict, we, the jury, impanelled on the coroner's jury recommend that our present mining laws be amended and new laws be enacted as follows:

1. That the State and Federal Coal Mine inspectors be given power to close any coal mine or part thereof where said inspector finds any hazard that he considers dangerous to the health and safety of employees.

2. That blasting of coal be not permitted when men are working in the mine, unless permissible powder is used.

3. That every underground employee be furnished with self-rescue equipment.

4. That helmets and gas masks in workable condition, in sufficient quantities, be kept at the mine to supply rescue crews in case of emergency.

5. That rescue crews be trained for rescue work and be supplied with all necessary equipment.

6. That all coal mines be rock-dusted.

7. That ventilation systems be improved immediately when requested by mine inspectors, and that booster fans be discontinued.

8. That a competent employee, selected by employees, must also accompany the state mine inspector on his official mine inspection.

9. That the intake air system should be on the man-way or haulageway when the mines have regular man trips.

10. That each local union of the mine involved be furnished a copy of each mine inspector's report.

In testimony whereof, the said Coroner and Jurors of this inquest have hereunto set their hands, the day and year, to-wit, this 14th day of April, A. D. 1943.

Signed:

C. S. Chamberlain,
Edward Bloom,
Eli Pekich,
J. J. Gerondale,
Celeste Roat,
John Mikesell,
John Mance,
Anton Columbus,
William C. Godina.

ATTEST:
Edward Olcott, Jr.,
Coroner of Carbon County, Montana.

List of Men Killed in Mine Explosion at Smith Mine of Montana Coal & Iron Company February 27, 1943

NAME	AGE	MARRIED OR SINGLE	NO. DEPENDENTS IN ADDITION TO WIFE
James Allison	51	M	2
Emil Anderson	40	M	1
Sam Alexander	57	M	0
Wm. Appleton, Sr.	50	M	0
Sam Barovich	56	Widower	2

Wm. F. Barry	26	M	1 Prospective
William Beeney	53	M	0
Jules Besinque	51	M	1
John Bone	59	S	0
Leland Cline	28	M	1
David J. Davis	42	S	0
William DeBourg	55	M	0
August Deruelle	62	M	0
Patrick Doran	38	M	0
Marcel Fages	40	S	0
Joe Ferro	51	S	0
John Germanetti	60	M	1
Pete Giovetti	39	M	3
Matt Hallila	57	S	0
Art Halpin	42	M	2
A. D. Hardy	42	M	0
James Hawthorne	30	M	1
John Hodnik	31	M	0
Walter Joki	30	M	1
Wayne Jones	31	M	0
Andrew Jordan	21	S	0
Mike Kerinko	33	M	4
John Krop, Sr.	59	M	0
Louis Kuhar	56	M	0
Edward Kumpula	35	M	1
Edward Laird	55	M	0
Edw. J. Laird	49	M	1
Clem Lodge	51	M	0
Abe McDonald	59	M	0
Joe McDonald	32	M	2
Robert McDonald	42	M	3
James McNeish	65	M	0
John Maden	53	M	0
Ignac Marinchek	57	S	0
Frank Mourich	42	M	1
Jack Mourich	36	M	2
Richard Mallin*	68	M	0
John Meiklejohn	51	M	0
Herman Mejean	19	S	0
Joe Meyer	39	M	1
Wilbur Muller	22	M	1
David Murray	56	M	0
Earl Mus	51	M	3
Wm. A. Nelson	51	M	0
William Noble	68	M	0
Frank Pajnich	53	M	0
William Pelo	46	M	2
Elmer Price	53	M	0
William Pryde	32	M	2
Eino Rahkola	27	S	0
Fred Rasborschek	61	S	0

Martin Ratkovich	46	S	0
David B. Reid	33	M	3
Lawrence Reid	41	M	2
Geo. J. Saarela	33	S	0
William Shepard	69	M	0
William Slaby	38	M	1
David Sommerville	60	M	0
John Sommerville	34	M	2
Frank Starkovich	64	M	0
John Sudar	28	M	1
Frank Sumisek	65	S	0
Geo. Thomson, Sr.	63	M	0
Adam Wakenshaw	72	M	0
Robert Wakenshaw	39	M	1
Robert Whitehead	47	M	0
Clarence Williams	42	M	1
Lloyd Williams	45	M	2
Vid Zaputil	50	M	0

*Richard Mallin was the uncle of President W. A. Boyle.

Respectfully submitted,

District No. 27,
UNITED MINE WORKERS OF AMERICA

W. A. BOYLE, President,

JOE YANCHISIN, Sub-District Board Member,

JOE MASINI, International Board Member.

TEN YEARS OF SAFETY SERVICE WITH CLOSED LIGHTS

By

GEORGE H. DEIKE, Mine Safety Engineer
Mine Safety Appliances Company

Mine Inspectors Institute of America

1925 Meeting

●

PEORIA, ILLINOIS

May 19th, 1925

In the report of the committee on Standardization of Mining Laws of the Mine Inspectors Institute of America, submitted and adopted by the Institute at its annual meeting in 1924, in Cincinnati, it is significant that section 1 of that report is on the subject "Illumination" and reads as follows:

"It is the desire of the Committee on Standardization of Mining Laws of the Mine Inspectors Institute of America that the State Coal Mining Laws in the various coal producing states of the United States be so amended by January 1, 1926, or as soon thereafter as the state legislature of the states may convene that the use of open lights be prohibited in all coal mines, except anthracite mines, delivering coal by rail or water and in all other mines where, in the opinion of the State Mine Inspection Department, it is necessary. Provided that in mines where the approved electric cap lamp is used, approved flame safety lamps shall be used in conjunction with the electric cap lamp at all places designated by the District Mine Inspector.

"All flame safety lamps that shall be used for testing purposes shall bear the approval plate of the United States Bureau of Mines, and shall be magnetically locked and the igniter maintained in a safe and serviceable condition.

"Mines not shipping coal by rail or water may be required to comply with the above regulation at the discretion of the Inspector of the District in which the mine is located.

"The Operator shall search, or cause to be searched, any person entering or about to enter any mine to prevent such persons from taking or carrying therein any intoxicating liquors, matches, pipes, cigars, cigarettes, or any device for making lights or fire not authorized or approved."

There were ample reasons for the adoption of such an important recommendation, which has been accepted generally as one of the foremost progressive steps taken in the interests of greater safety for the underground workmen. You are to be commended for adopting and presenting for consideration this eminent safety measure.

In searching for the reasons for the action taken it is very apparent that the record of the open light has proven disastrous, while the enviable record with closed lights during the past ten years, has been most impressive. It is timely that this subject be reviewed and made a matter of record, and with your kindly permission this forms the basis upon which the present paper has been prepared. In it we will endeavor to outline the reasons for the development of the electric safety cap lamp for general underground illumination; give some insight into the progress which has been made in the introduction of these lamps and improvement in mine lighting, and in summing up, present the excellent record of safety service which has resulted therefrom.

The need for study in the interest of greater safety in coal mining came to the attention of the country at large, and to the mining industry in particular, following the exceptionally disastrous mine explosions which occurred in this country in the year of 1907, in which 690 men were killed. Over a period of years preceding 1907 the number of mine fatalities from all causes had been on a steady increase, and the number killed per 1,000 employed jumped from 2.84 in 1896 to 4.88 in 1907. On the other hand if we consider only the men working on a 300-day a year basis we have the rate in 1907 as 6.24 per 1,000 employees.

This very deplorable increase was accounted for by the fact that the methods of mining were rapidly changing throughout that period; tonnage was increasing at an unprecedented rate; and the introduction of electric machine mining and haulage presented additional hazards.

This alarming condition brought about the activity among mining men and the general public which resulted in the formation of the Bureau of Mines, by governmental action.

In May, 1908, Congress authorized the United States Geological Survey to investigate the causes of mine explosions, with a view of increasing safety in mines. This work was taken up under the direction of Dr. Holmes and such progress was made that in 1910 a separate government bureau was created to carry on this important work.

Naturally in a study of mine explosions the first requisite was to determine the principal causes of same, and it was early apparent in these studies that the open light presented by far the greatest hazard. From 1896 to date, the records show that open lights have been responsible for 70 per cent of the fatalities resulting from major mine explosions. A major mine explosion is considered one in which 5 or more fatalities occur.

The records available show that during the last 18 years open lights have started 129 coal mine explosion disasters costing the lives of 3,154 men, and not including numerous ignitions of gas or dust with less than five fatalities.

Open lights started during that period 11 coal mine fire disasters, causing 414 deaths and these and countless other coal mine fires, without fatalities, caused by open lights have cost many millions of dollars in property damage. Last year, 1924, there were three explosions started by ignition of gas from open lights killing 324 men. Do we need any further proof than these figures covering the hazards of the open light? While this condition had been sensed by safety engineers, who have been studying this subject for the past 10 or 15 years, I doubt if any of them realized fully to what extent the open flame was involved in the mine disasters of this country until statistics given, similar to those above, were made available during the past 12 months.

Among the records we find the open light hazard and the need for electric safety cap lamps well presented in the "Report of Investigations, Department of the Interior, Bureau of Mines, January, 1924, by L. C. Ilsley, and M. W. Von Bernowitz" from which the following is taken:

"Several hundred thousand open lights are daily carried in coal mines of the United States, each lamp being a menace to life and property through fire or explosion. They have been responsible for many disasters in the past and will be again. But there are still more than twice as many open lamps as electric lamps in our mines, and the open lamps should be discarded in favor of an approved type of electric lamp."

* * *

"An open light and gas constitute a vicious hazard; while if there be coal dust present in the vicinity the consequences are multiplied many times. An open light and black blasting powder also constitute an explosion hazard, vividly attested by several serious disasters.

"It has been argued for many years, and still is seriously stated, that because gas has never been detected in a mine the probability is that it never will; consequently open lights are used. A chance is taken. What is the result? For a while—perhaps years—nothing happens, then one day there is either a gas ignition or a violent explosion, killing and injuring many men, and more or less damaging the mine."

* * *

"Nobody can say that gas will not be encountered, but it can be said that it may be sooner or later. Therefore, as a definite safety measure, the Bureau of Mines holds that the possibility of a gas release is ever present in coal mines, and that closed lights should be used. In other words, the open light is unsafe."

In concluding their report the situation is summed up as follows:

"In fine, it would appear that the danger from open light and gas is either not understood or realized, or is ignored by many engaged in mining coal."

With the evidence that the open light was the greatest hazard in so far as coal mine explosions were concerned, the next step was to get a safety lamp which would be practical as well as acceptable to both operators and miners.

Flame safety lamps had been used in gaseous mines for almost 100 years and until the year 1911 they were the only type of safety lamp used in this country. Referring to Bureau of Mines Bulletin No. 227 on Flame Safety Lamps, by J. W. Paul, L. C. Illsley and E. N. Glein, we find the following statement in the introduction:

"In 1911 approximately 45,000 Flame Safety Lamps and no electric lamps were being used in the Pennsylvania Bituminous Mines, which were then producing 35 per cent of all the soft coal mined in this country; by 1918 the flame lamps had decreased to 17,000, whereas electric lamps—mostly of one make—totaled nearly 48,000."

The indications are that considerably less than 10 per cent of the coal miners in this country were protected by safety lamps previous to the introduction of electric safety cap lamps. It was difficult to get flame safety lamps more generally introduced at that time because they gave less light than the open flame lamps and were not as simple in construction, but were more cumbersome, and had to be carried by hand. These objectionable features could not, as a general proposition, be overcome.

Because of these unalterable objections to the flame safety lamp, attention was directed to the electric type of mine lamp which had been first introduced into this country from Europe about 1909, but which had been used to some extent abroad some ten years earlier. These foreign lamps, however, were of the hand lamp type so that the principal objection still remained and it was necessary to interest storage battery manufacturers, in this country, in the development and production of an efficient electric safety lamp, of the head or cap type.

This development work on the part of several manufacturers, assisted by a number of prominent electrical engineers throughout the country, brought

about a situation which enabled the Bureau of Mines in April, 1913, to issue schedule of approval No. 5, covering conditions and requirements for testing electric mine lamps. This schedule covered safety only, and was later amended in February, 1914, by schedule No. 6, this latter again being supplemented by schedule 6-A in February, 1915, which included requirements both for safety and practicability of the lamps to be tested.

The first approval, No. 10, under this schedule, was granted during the year 1915 to the Edison Storage Battery Company, followed by later approvals to the Manlite Lamp; Concordia Hand Lamp; Wico Lamp; Concordia Cap Lamp; General Electric Lamp; Pioneer Lamp and Wheat Lamp.

Since the first approval the number of electric safety cap lamps has been rapidly increasing so that there are at the present time approximately 230,000 permissible electric safety cap lamps of four different makes in service in the mines of this country (of this number 90 per cent are of the Edison type). There are about 30,000 flame safety lamps to be found in the Bituminous Mines of this country for testing purposes and legal reserve, but there is no record of any bituminous mine, in this country, now working exclusively with flame safety lamps. In the anthracite field of Pennsylvania we find some 25,000 flame safety lamps but here again in one mine using them exclusively for working purposes. These figures are proof of the excellent results as to the safety, efficiency, and practicability of the electric cap lamp for general illumination underground. They would not have been adopted so readily had they not met all practical requirements in addition to safety.

It is generally admitted that the mine explosion hazard has been greatly reduced in the so-called gaseous mining districts. Naturally it was in those districts that the larger number of electric cap lamps have been installed. Previous to the year 1914 the greater number of mine explosions occurred in admittedly gaseous districts, but this condition changed with the introduction of the electric safety cap lamps so that since that year the scene of the major explosions has been changing, and the greater hazards are found in the so-called non-gaseous fields where the greater number of ignitions have occurred due to the more prevalent use of open lights.

A survey of the records of mine explosions, or better, the cutting down of explosions in districts and mines where electric safety cap lamps have been installed during the past ten years, leads one to conclude that the electric safety cap lamp has in a large measure brought about this reduction, in the explosion hazard. This conclusion can be drawn also from the fact that 70 per cent of the mine explosions in this country have been caused by open lights. If we discard this principal cause of these accidents the results naturally will make themselves apparent in the reduction of such catastrophes.

Not only can mine explosions be reduced in number but they can be practically eliminated and this is demonstrated by the record of Great Britain in the year 1924. They employ approximately a million men underground but only 6 per cent of all these underground employees use open lights. They killed last year a total of but 35 men from explosions, as compared with our 536. Out of these 35 men, in Great Britain, more than one-half were from open light mines, representing 6 per cent of the production, showing once again the dangerous factor of the open light.

In all that has been presented we can follow the record of achievement along the lines of safety with electric cap lamps, and your committee, in endorsing the use of closed lights exclusively, not only had the records from our own country to go by, but also the regulations laid down by the different European countries covering lighting. As a matter of information the various laws governing the exclusive use of closed lights abroad are inserted here:

AUSTRIA

(Translated from the Ordinance of the Imperial Chief Mine Directories, Vienna, dated 20th October, 1902.

Mine Lighting

Para. 30. The use of open lights and furnaces of any kind is only permitted in shafts in the downcast current, and in entries and engine rooms adjoining same, if these are walled in and otherwise secured against fire.

For mine lighting, except in the cases above mentioned, only safety lamps and portable electric mine lamps may be used in accordance with the stipulations in Paras. 31 and 32.

BELGIUM

Flame Lamps

Translated from the Royal Decree of 9th August, 1904.

(a) Mine without fire-damp.

Article 1.—Lighting by means of candles, torches and other means with the flame completely unprotected is forbidden.

Article 2.—There shall be kept in storage at the mine sufficient safety lamps in good condition to permit of the inspection of places where the presence of inflammable gas may be suspected.

(b) Fire-damp mines.

Article 3.—Lighting shall be by means of safety lamps provided by the owner; these lamps shall be of a type approved by Ministerial Order in pursuance of this Regulation.

FRANCE

Translated from Direction des Mines Circular No. B3 of February 22, 1912, to Prefects of Departments.

Part IX.—Lighting

Section 1.—General Provisions.

Article 144.—In gassy mines and in dusty mines of the First Category (a) as well as in the suspected districts referred to in Article 131 (b) no lights shall be used other than a safety lamp; provided that, except in mines liable to sudden outbursts of gas, flame-protected (c) lamps may be used in the shaft and in intake insets.

Article 145.—In non-gassy mines, if safety lamps be not used, no light shall be used other than a flame-protected lamp. In every working place in such mines, there shall be at least two flame safety lamps in good order.

GERMANY

PRUSSIA

Translated from the Order dated 1st January, 1911.

VIII—Lighting

1. General

Para. 164

(1) The use of naked lights is forbidden in all parts of mines with the exception of the shaft-bottoms of down-cast shafts leading to the open and the engine-rooms, in so far as the shaft bottoms and engine-rooms are constructed only of stones, brick, or iron casing and contain no inflammable material, not even temporarily. In such shaft-bottom and engine-rooms naked lights are only permissible in stationary or hanging lamps, and only then if these lamps are enclosed by glass, proof against being shattered, and, when petroleum, spirit and other easily inflammable liquid fuels are used for lighting material, if these liquids are completely absorbed by suitable materials.

Translated from the General Order of the Mining Police for the Royal Head Mining Board in Breslau, dated 1st January, 1900.

Section 116

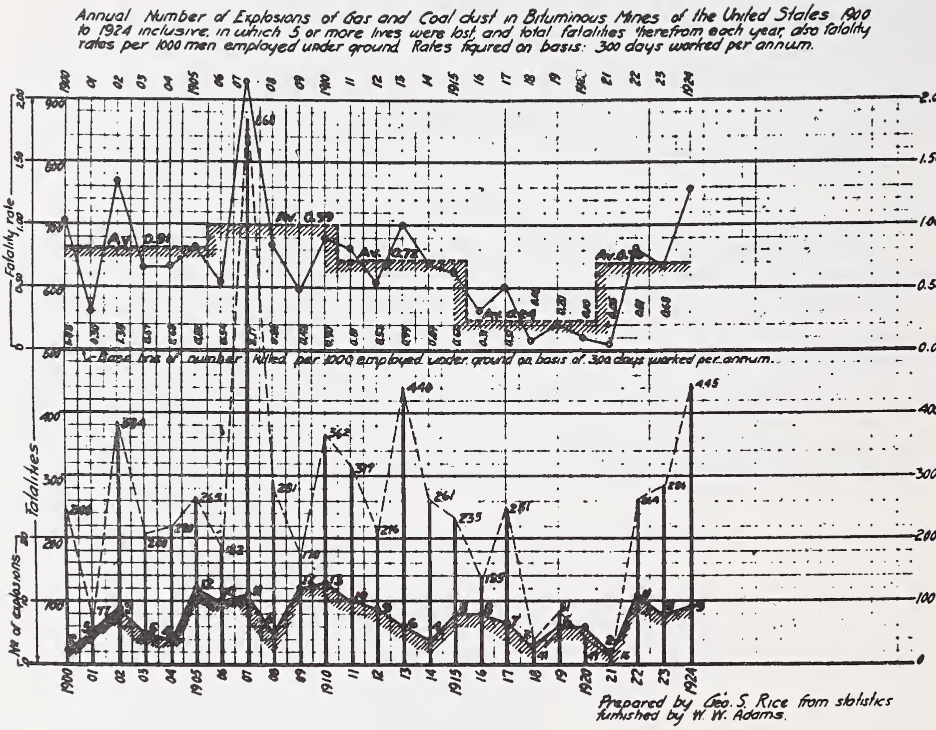
Open Lights Prohibited

The use of open lights is prohibited everywhere underground (in stables, stores and such like places) where there are any easily inflammable articles (hay, straw, cotton waste, etc.) as well as in underground rooms which have any wood about them and contain machinery worked by steam.

From the year 1870 to 1906, inclusive, the available records show that 2,537 men were killed by gas explosions, and 1,464 men were killed by gas and coal dust explosions. A total from these two causes of 4,001, or 14.8 per cent of the total coal mine fatalities underground in the United States.

From 1907 to 1913, inclusive, 916 men were killed by gas explosions and 2,374 deaths were attributed to gas ignitions propagated by coal dust, or a total of 3,290 or 19 per cent of the total killed underground during the period of years. The following gives the percentage of accidents due to gas or gas and dust from 1913 to 1923, inclusive:

1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Gas Explosions—										
3.27	13.53	6.74	7.64	7.31	3.68	6.21	5.72	4.83	6.82	9.22
Gas and Dust Explosions—										
15.19	.69	6.66	2.51	6.04	1.32	2.03	1.50	1.01	8.90	4.76
18.56	14.22	13.40	10.15	13.35	5.00	8.24	7.22	5.84	15.72	13.98



From this tabulation we notice a decided improvement from 1913 to 1921, inclusive, during which period many thousands of electric safety cap lamps were installed. This very material reduction in mine explosion fatalities is a great tribute to this type of safety equipment.

But you may ask what of the increases in 1922, 1923 and the really disastrous year, 1924, the figures for this latter year having been given previously. Let us take the list of mine explosions for that three-year period and analyze the cause. The answer is, the open light, for in that three-year period explosions caused by open lights numbered 21 with a total of 598 lives lost and 147 injured. The remedy naturally would be the general adoption of closed lights, eliminating this hazard.

Why is it with all this convincing evidence that all the mines in this country are not on closed lights exclusively? Merely because we have chosen to adhere to an ancient custom in classifying various operations as gaseous or non-gaseous. The fact of the matter is there is no such coal mine classification as "NON-GASEOUS," and this Institute has publically gone on record to that effect.

I had the opportunity several years ago of stating our opinion relative to the so-called non-gaseous designation of coal mines as it has been our contention ever since entering the Mine Safety Field that it was impossible to forecast future gas conditions in any underground coal mining operation. It was in 1917 at the annual meeting of the National Safety Council, in New York City, that

we presented a paper on "Advantages of Permissible Electric Lamps in Non-gaseous Mines," and in the introduction to that paper this statement was made, which is even more significant now than at that time: "From the standpoint of a Safety Engineer gained after several years of service in mining practice, I am led to an expression of opinion which precludes the designating of any underground operation as non-gaseous. To do so would be to forecast the future as to whether certain underground operations would encounter gaseous conditions. All classifications, past and present, along these lines are based upon the past record of the individual operation or some particular district under discussion."

One of the accidents included in the previous figures for the year 1924 was the Castle Gate Explosion, at Castle Gate, Utah. Following that explosion the Utah Industrial Commission formulated a safety code for the coal mines of that State, and RULE THREE of those regulations concerning mine lighting reads as follows:

"LIGHTING: All men entering coal mines in Utah in which more than five men are employed on any one shift shall be equipped with electric lamps approved by the United States Bureau of Mines and no flame lamps shall be permitted in the mine, except for testing purposes. All lamps used for testing purposes shall bear the approval of the United States Bureau of Mines and shall be magnetically locked and the igniters shall be maintained in a serviceable condition. Mines employing five men or less on any one shift may be required to comply with the above regulations at the discretion of the Industrial Commission of Utah."

This ruling was objected to by the Carbide Manufacturers and finally on February 26, 1925, a meeting was held by the Industrial Commission, in Salt Lake City, at which time expert witnesses submitted testimony which proved conclusively that the electric safety cap lamp was the outstanding equipment which was cutting down the mine explosion hazard, and as a result of the hearing RULE THREE of those regulations remained unchanged. All the coal mines in Utah have been on closed lights since July 1, 1924, this being the first State in the Union to follow out the recommendations outlined by the Mine Inspectors Institute covering mine lighting. The Industrial Commission, the Mine Inspectors, Operators and Miners of Utah are to be congratulated upon this great achievement in the interests of mine safety.

There are several outstanding features in connection with the testimony submitted at that hearing which I would like to present at this time for your consideration:

Daniel Harrington, Consulting Mining Engineer of Salt Lake City, in submitting his brief to the Commission states that the Utah Industrial Commission, in absolutely barring open lights from the coal mines of that state, instituted a procedure that was "one of the most forward steps toward coal mine safety in the history of coal mining in the United States." He further testified as to the safety service rendered by the electric safety cap lamp in the following words: "During the eight months which have gone since the introduction of electric safety cap lamps in the Utah mines, not a life has been lost because of lights or lighting. In fact, where government records show practically 3,000 lives lost in the 17-year period, in the mines of the United States, due directly

or indirectly to open lights there is not, so far as my information goes, record of the loss of a single lifs due directly, or indirectly, to the electric safety lamp."

The above statements are indeed most convincing. He also goes on record in his testimony as to the classification of gaseous or non-gaseous mines in these words: "An inspection of the record of the explosions of the United States for the past 25 years reveals the fallacy of the attempt to classify mines as gaseous or non-gaseous. While there are dozens of definitions to distinguish between the two classes, the real definition should be that all coal mines are potentially gaseous and should be operated at all times under such precautionary practices that, irrespective of the changes as to gas, the mine will be safe. In the past the rule seems to have been that a mine is operated as non-gaseous, hence allowed to use open lights until an explosion occurs, with heavy loss of life, after which it becomes classified as gaseous, and closed lights are used."

The second witness to appear before the Industrial Commission was Bert W. Dyer, Mining Engineer of the United States Bureau of Mines, and Chief Inspector for the State of Utah. In the brief submitted by him he outlined the advantages which had come about because of the introduction of electric safety cap lamps following the adoption of the Utah Mine Safety Code. He itemized these advantages as follows:

1. "The present lighting law now in effect in the coal mines of Utah minimizes the hazards of gas explosions.

2. The present lighting law reduces the hazards of burns from the ignition of gas by open flame lights.

3. Closed lights greatly reduce the hazard of coal dust explosions.

4. The closed light greatly reduces the mine fire hazard. The two large coal mine fires in Utah which cost approximately $1,000,000 are thought to have been caused by open lights.

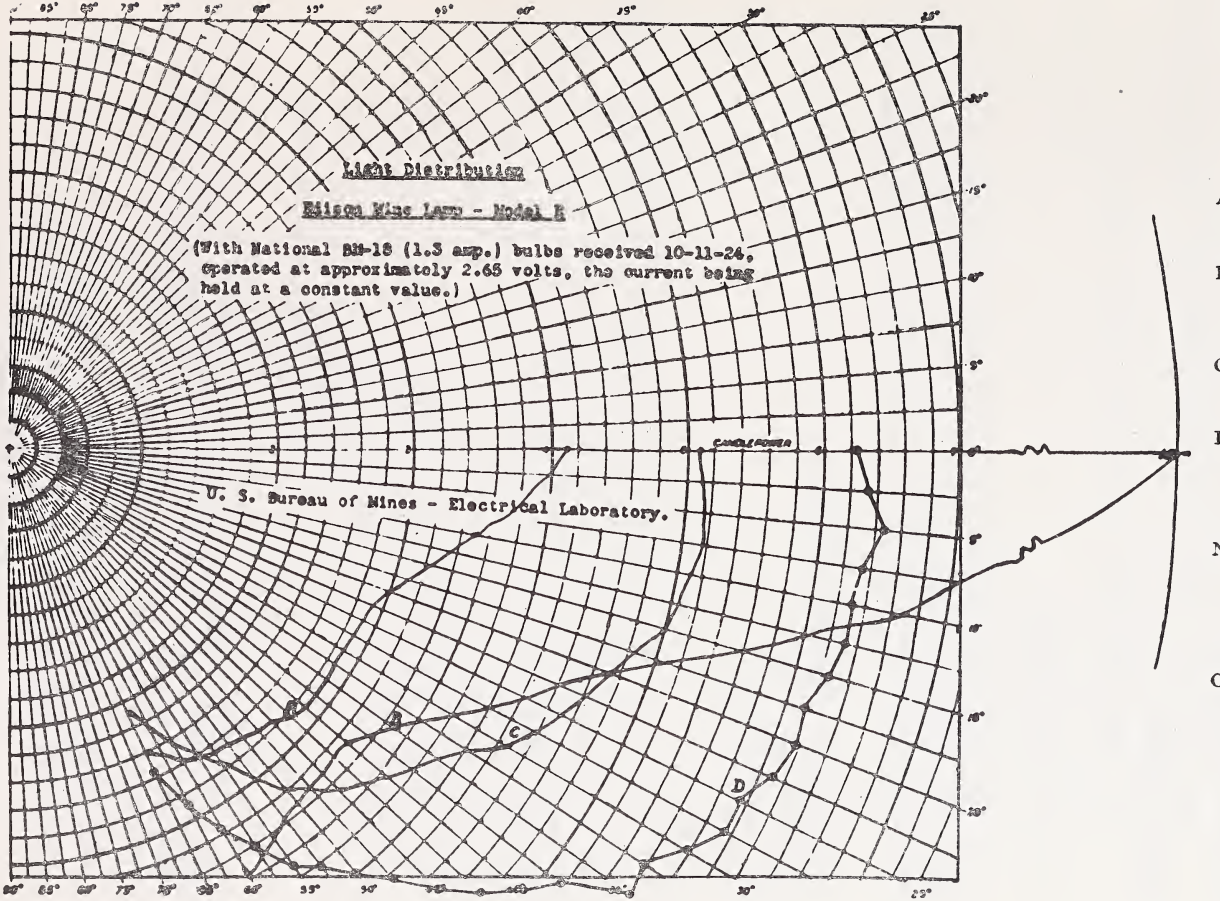
5. The closed light reduces accidents from fall of rock, roof and coal, etc., by the illumination being more uniform.

The open light gives its illumination through a very limited area making more or less of a sharp point which is confined mostly within an angle of ten (10) degrees while the approved electric safety cap lamp the arc of illumination is not less than one hundred and thirty (130) degrees.

The open light is continually varying in its amount of illumination while with the approved electric cap lamp the amount of illumination must remain constant over a twelve (12) hour period.

The tests made with the open flame carbide lamps using an average of 1⅛ inch flame with tarnished reflectors gave a maximum of four and one-tenth (4.1) candlepower. However, the reflectors used were in about the same condition that a new lamp would be after being used a short time, with the exception that the reflectors were clean, whereas in use the reflectors would quickly become dirty as well as tarnished, and the above candlepower value further reduced.

Tests made with Edison electric safety cap lamp with new approved bulb gave six and two-tenths (6.2) candlepower at center of light distribution, over



A—Carbide lamp with tarnished reflector and flame 1⅛" long.

B—Carbide lamp with polished reflector and flame 1⅛" long.

C—Edison lamp, model E, with BM-18 bulb.

D—Edison lamp, model E, with new approved bulb.

NOTE—Curves A and B from tests made by National Lamp Works. Average of 4 types of carbide lamps.

Curves C and D taken from approved tests of Bureau of Mines.

six (6.0) candlepower through an arc of approximately fifty (50) degrees and over five (5.0) candlepower over an arc of approximately eighty (80) degrees.

It is very evident, therefore, that the approved electric cap lamp with its more uniform, constant and greater illumination over a much larger area of light distribution is one of the most powerful factors in safeguarding the miner at the working face from falls of rock, roof coal, etc.

NOTE:—The light distribution curves attached bring out very conclusively the greater lighting values of the approved electric cap lamp.

6. The closed light used in coal mines undoubtedly greatly reduces the haulage accidents.

7. The closed light reduces accidents from handling explosives.

8. Closed lights greatly increase the opportunity for workmen to escape in case of a mine explosion.

It will be stated by many that the electric cap lamp is not necessary in non-gaseous mines. The so-called non-gaseous mines have become gaseous over night, and a striking example of this is the Cass Mine in Colorado. Attached is a copy of a letter from Mr. James Dalrymple, Chief Mine Inspector, giving the details of the sudden accumulation and disappearance of explosive gas."

Mr. B. W. Dyer, Chief Mine Inspector,
U. S. Bureau of Mines,
438 State Capitol,
Salt Lake City, Utah.

Dear Sir:

I am in receipt of your letter of the 14th, concerning the Cass Mine near Hasting. This mine was opened up and worked for about three years. During this time no indications whatever of explosive gas was found. Later some pillars were pulled in one of the east entries. A large cave took place at this point during the night. The fireboss, upon entering the mine the next morning encountered a very large body of explosive gas. It took three days and three nights to remove it. It was over one year ago that this happened. No explosive gas has been found in Cass Mine since.

Hoping that I have given you the desired information, I beg to remain,

Yours truly,
JAMES DALRYMPLE,
State Inspector of Coal Mines.

Following the admission of the brief submitted by Mr. Dyer, the Chairman of the Industrial Commission, Mr. McShane, called G. S. Rice, Chief Mining Engineer, United States Bureau of Mines, to the stand and proceeded with the examination by direct testimony. Some of the facts presented are pertinent to this paper and are given herewith:

MR. McSHANE—How is fire damp usually ignited?

MR. RICE—By open flame and long flame explosives.

Q.—How is coal dust usually ignited?

A.—By Prior Ignition of fire damp and by long flame explosives.

Q.—Can coal dust be ignited by other means than by blasting or by an electric arc, or spark when no fire is present?

A.—Yes, by open light.

Q.—Is there evidence other than experimental testing to prove this?

A.—Ample evidence. There are many instances.

Q.—From your testimony and from investigations after explosions do you believe that explosion disasters can be prevented?

A.—Yes.

Q.—By what and how can this be done?

A.—By preventing ignition and preventing propagation. That is to say, by preventing ignition, preventing any source of flame reaching the ignitable material. By preventing propagation means to render the coal dust inert. There is no means of rendering fire damp inert, but we feel that coal dust can be rendered inert.

Q.—Is it then your idea that both methods of preventing ignition and of preventing propagation of an explosion once started should be used by mine operators?

A.—It is. It is highly necessary that both should be done.

Q.—I wish you would elaborate on anything you think would be of value to the Commission in reaching a proper conclusion on the prevention of ignitions in coal mines.

A.—The prevention of ignition is by use of what we call and what are termed "permissible safety lamps" and "permissible explosives" and use of "permissible electric machinery," wherever there is special exposure to the possibility of gas. The prevention of propagation as far as we know at present is through two means. One is watering and another rock dusting. Watering was the system well known, used in this country in general, but generalized watering has not been effective because it requires so much water that it is practically impossible to carry it out. The ventilating air currents dry the water so fast. In our experimental mine we have found that to wet fine coal dust it takes 30 per cent of water in the mixture."

* * *

Q.—You have stated that explosions in this part of the county were largely caused by open lights?

A.—Yes.

Q.—In view of that do you consider the Utah Industrial Commission's order requiring closed lights a good safety measure in all coal mines in Utah?

A.—I do. I think it is one of the most admirable steps taken in the interest of safety.

Q.—Would you consider it covers non-gaseous mines?

A.—I do. I consider the term "Non-gaseous" purely irregular. In all coal mines you may encounter gas.

Q.—What is the view of the Bureau on this matter?

A.—I am fortunately able to give this. The Bureau has for years made reports, which have confidentally gone to operators, making recommendations for the use of closed lights and permissible explosives; those recommendations of necessity could not be made public because the Bureau only has recommendatory power. Its greatest function is research, leaving to the State police power and carrying out their regulations. However, Director Bain, in order to formulate certain questions relating to safety so there should be the same method of making recommendations, established a Mine Safety Board, of which I am Chairman,—and the Board last spring took up as one of the earliest questions the matter of open lights in mines, and recommendations were made to the Director that open lights be no longer used, and finally this was put into form about six months ago but was not acted upon by the acting Director until recently because of the absence of Director Bain. I would like to put into the record this letter which has been given me by the Acting Director.

"Dear Mr. Rice:

"The recommendation submitted by you under date of November 12, 1924, as Chairman of the Mine Safety Board of the Bureau of Mines, as a result of careful consideration by the Board of all the various matters involved and reading as follows:

'The Bureau recommends that:

'(a) In all coal mines the portable lamps for illumination be permissible, portable, electric mine lamps; and also,

'(b) In places where fire damp or black damp is liable to be encountered, a permissible magnetically locked flame safety lamp for gas detection, or equivalent permissible device, be supplied to at least one experienced employee in each such place; and

'(c) Any employee before being supplied with a permissible flame safety lamp be examined by a competent official of the mine to assure the man's ability to detect gas; and

'(d) All coal mines whether classed as non-gaseous or gaseous in any part, be supplied with magnetically locked, permissible, flame safety lamps, properly maintained and in sufficient number for all inspection purposes.'
has been considered and approved in accordance with the gen-

eral order of May 20, 1924, as the basis of teaching and policy of the Bureau."

In one of the exhibits submitted by Mr. Rice during his testimony we find these very pertinent statements:

"The Bureau of Mines has for many years recommended the use of permissible miners' lights in any mines making gas but as most of the explosion disasters have occurred in mines rated as non-gaseous and as its investigations in the mines of the country have shown that fire damp may be encountered in any coal mine, the Acting Director of the Bureau, D. A. Lyon, has authorized the public issuance of the foregoing recommendations."

"It is hoped and expected that in view of the many explosions and fire disasters which are started by open light ignitions that the mine operators of the country will put into effect these recommendations as rapidly as possible."

From the preceding testimony we have the recommendation of the Mine Safety Board of the United States Bureau of Mines endorsing permissible portable electric mine lamps in all the coal mines of the country, and said recommendation was approved February 11, 1925, by the Director of that Bureau. This endorsement by the bureau of Mines of the use of closed lights exclusively in the coal mines of this country is most timely.

Mr. J. W. Paul, Chief of Coal Mining Investigations, United States Bureau of Mines, was the last witness called at the hearing and the following questions and answers are of very considerable interest in the presentation of this subject.

MR. McSHANE.—Have you made any special study of the cause of mine explosions?

MR. PAUL—Yes, that has been a part of my duties in connection with the work of the Bureau of Mines, since all of the mine explosion reports made by other engineers of the Bureau come to my attention for review, before they are finally completed and forwarded to the operator of the mine concerned.

Q.—What, if any, attention have you given to the study of mine lamps?

A.—Part of my work with the Bureau of Mines was a study and testing of mine lamps and I have conducted tests on different types of lamps, and on safety lamps, and prepared the first official schedule for the testing for permissibility.

Q.—Will you give us a brief history of lamps, their dangers and disadvantages, etc.?

A.—The general development of lamps in coal mines has been from the oil burning lamp in which lard oil or similar oil was used. That was followed by the use of cotton-seed oil and often with mixtures or mineral oils such as kerosene, and that lamp was superceded with a lamp which burned a waxy material called Sunshine, and that was followed by the carbide lamp. The danger of the wick lamp was that sparks would fly in the air and often-times come in contact with powder, causing explosions. With the introduction of carbide lamp this danger

to a certain extent was minimized in that it gave off no sparks, but its flame was more intense than the other lamps and would more easily ignite a cloud of coal dust than the other flame lamps.

Q.—What are the principal dangers of the use of open flame lamps in non-gaseous mines?

A.—The liability of igniting combustible material such as brattice and timbers, and bodies of explosive gas.

Q.—What is the relative candlepower of open flame and miners' electric lamps?

A.—In 1915 the Bureau published, in Miners Circular 18, the result of some investigations I conducted, in which will be found on page 8, a statement of the relative candlepower of carbide lamps and miner's and driver's lamps burning oil. This gives the candlepower of the carbide lamps as ranging from 4.2 to 6.2 head-on when fitted with a reflector, with a flame 1 to 1⅛ inches long, and at right angles to the flame of 0.87 to 1.45. Without a reflector, the head-on candlepower of the lamps averages 1.9 to 2.15, and at right angles 1.9. With the miner's and driver's oil-burning lamps, when the flame is adjusted so as to give the most light, an average candlepower of 1.4 to 1.9. More recently the Bureau has made a test of carbide and electric lamps, which has been submitted as one of the Exhibits by Mr. Dyer and in which it will be found that the latest type of electric portable lamp gives a little over 6 candlepower over a range of about 70 degrees, as compared with carbide lamp giving a little over 4 candlepower over a much less range, probably over a range of 40 degrees.

Q.—Do we understand from the results of your research you have reached the conclusion that the latest improved electric lamp gives a better range of light and more uniform candlepower?

A.—Yes, it gives a better range of light and it gives a more uniform candlepower.

Q.—What is your experience as to non-gaseous mines becoming gaseous suddenly?

A.—I have known of quite a number of coal mines which have been operated for many years,—others for less period—which were classed as non-gaseous mines, suddenly developing in some part as gaseous and usually resulting in the ignition of gas, causing either injury or death on explosion, so it is not an uncommon thing for a mine to develop suddenly from a non-gaseous into a gaseous condition. We had an example of that the past year, in the Eastern part of the States—a mine that had been in operation for sixty years, and suddenly developed a gaseous condition with the loss of over 100 lives through ignition by an open flame lamp.

Q.—Do you have any knowledge of non-gaseous mines becoming gaseous through interruption of operation?

A.—The Bureau of Mines conducted an investigation a number of years

ago in a number of mines in which special tests were made and samples of air were taken in mines where it was the custom to slow down or stop the ventilation of the mine during shot firing time, and while the mines were classed as non-gaseous, the tests showed that the stopping of the ventilation for a short time resulted in explosive gas collecting in the mines.

Q.—Is there any record of which class of mines the greatest number of explosions have occurred—gaseous or non-gaseous.

A.—From what I have studied the greatest number of explosions have occurred in what have been classed as non-gaseous mines.

Q.—Do you have any knowledge of the beneficial use of portable electric lamps in mines where roof conditions are bad?

A.—I am familiar with the location and operation of a mine of which I have a record here, which recently appeared in a publication which I will submit—which probably will answer your question. I will read a few lines of this and leave it as an Exhibit:

"A company operating three mines in the Freeport bed near Pittsburgh, with an average of 1,000 to 1,200 employees, successfully operated its mines for more than four years without a fatality to any employee inside the mines. Production during this period exceeded five million tons.

"Another one of the largest producing companies in the Pittsburgh district operating in the Pittsburgh bed, and having the dangerous draw-slate and other hazards such as gas and coal dust, has set a new record for production per fatality for the year 1924, reaching the high record of 754,000 tons per life lost."

I might say these mines mentioned in this Exhibit are using exclusively portable electric lamps.

Q.—And were, during all this period?

A.—Yes, and they have had roof conditions the danger of which apparently from this statement have been very much improved, largely attributed as they claim, to better lighting given by these portable electric lamps.

It is needless to state that after all this testimony was submitted that RULE 3 on LIGHTING remained unchanged in the Utah Safety Code.

We have the satisfaction, therefore, of seeing within a twelve-month period, recommendations covering the use of closed lights exclusively in the coal mines of this country, coming from the Mine Inspectors of America, the Industrial Commission of Utah and the United States Bureau of Mines, and further endorsement, in the near future, from other departments is to be expected.

These recommendations have been made following ten years of satisfactory service with electric safety cap lamps. Also in that time the improvements made have been such that, today, a modern type of electric cap lamp gives more illumination than the open flame carbide cap lamp.

The maximum candlepower is 25 per cent greater than the acetylene lamp under every operating condition, and furthermore the electric lamp provides a symmetrical distribution of light with the highest candlepower in the center of the beam and with slightly decreasing values for the wider angles. This provides a desirable illumination free from shadows or sharp contrasts directly in front of the worker.

With electric lamps the light output is steady, decreasing slightly as the battery becomes discharged, while with the acetelyne lamps the candlepower is continually fluctuating. This fluctuating is caused principally by non-uniformity of the rate at which the water is fed to the carbide chamber, and further, because the carbide charge is gradually diminishing in strength.

The above comparison is given because of the further safeguarding of the individual, resulting from more uniform and greater illumination with the electric safety cap lamp.

There are many other advantages of electric cap lamps proven in the last ten years, but from the standpoint of safety only, we have, aside from the elimination of the explosion hazard, freedom from the fire hazard which frequently comes from the use of carbide lamps and carbide.

With the electric lamp the miner has nothing to do with the illumination results obtained. The bulbs are in the locked head-piece and freshly charged batteries are supplied at the beginning of each day's work. The complete outfits are maintained in good operating condition at one place, under the direction of a lamp man, whose responsibility is to keep the lamps in good condition. Thus with a limited number of trained men in charge of all the lamps for a given mine, a uniform high standard of performance is obtained.

Another very efficient service rendered by the electric safety cap lamp has to do with costs which had they been prohibitive would have prevented the general adoption of this great safety device. By comparison the cost of operating carbide lamps, including replacements, runs from 6 to 8 cents per lamp per day, while the electric cap lamp maintenance is from 1½ to 2¼ cents per day, over a five-year period. This includes depreciation and interest on investment. Adding cost of lamp-house labor, and all other chargeable items, we get a maximum total cost per lamp per day for the electric lamps, around 5 cents.

In the foregoing statements we have shown the great need for the use of closed lights exclusively in all the coal mines of this country; we have outlined how greater safety with electric cap lamps has been brought about in the past ten years; and we have shown development in the same period of time which has very greatly increased the efficiency of this type of safety equipment.

The adoption of electric safety cap lamps by the inspection departments, operating officials and miners of the coal mines in this country has been very rapid. We are proud of the fact that 40 per cent of the coal miners in this country are already equipped with closed lights, but the goal is 100 per cent equipped within the next few years. In striking out the term "NON-GASEOUS" from our glossary of mining terms, as your Institute, the Bureau of Mines, and the Industrial Commission of Utah have done, we acknowledge the need for 100 per cent closed light protection in the coal mines of this nation, and from experience such acknowledgement, upon becoming general with the mining industry, means their adoption exclusively in the coal mines of the United States.